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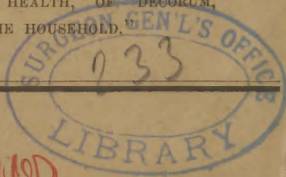
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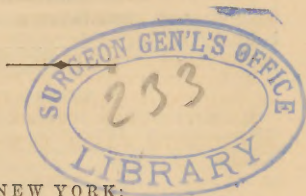
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CONTENTS.

INTRODUCTION	Page 11
--------------------	---------

CHAPTER I.

Air.—Its Necessity to Life.—Fatal Consequences of Disregard of this Fact.—Bad Habit of Children.—Dangerous Amusements	13
---	----

CHAPTER II.

The Quantity of Air required.—Two Modes of Suffocation.—Examples.—Stifed in School-rooms.—The Black Hole of Calcutta.....	18
---	----

CHAPTER III.

Importance of the Quality of Air.—Composition of the Atmosphere.—Oxygen.—Carbonic Acid Gas.—Its Dangers and Benefits.—Medicinal Springs	22
---	----

CHAPTER IV.

Carbonic Acid Gas in Nature.—The Dog's Grotto.—Carbonic Acid in Wells.—Dangers: how avoided.—Remedies for Poisoning by Carbonic Acid.—Effect of Plants on Carbonic Acid.....	26
--	----

CHAPTER V.

Carbonic Acid produced by Man.—Respiration.—Purpose of Inspiration.—Purpose of Expiration.—Pure Air the Antidote to Carbonic Acid.—Penetrating Power of Air.—Resistance of Man.—Ventilators.—Summer and Winter Ventilation.....	32
---	----

CHAPTER VI.

Atmospheric Impurities.—The Suffocation of the Elder Pliny.—Herculaneum and Pompeii.—Miasm.—	
--	--

Fever and Ague.—Poisons from the Household.—
Poisons of Cities: Smoke; Dust; Gas.....*Page* 39

CHAPTER VII.

Corruption of Air by Disease.—Contagion and Infection.—Epidemics.—Precautions.—Duty to the Sick.
—Hygiene 47

CHAPTER VIII.

Animal Heat.—Its Mode of Production.—How regulated.—Necessity of adapting Habits of Life to Climate and Season..... 55

CHAPTER IX.

Evaporation.—Conduction.—Radiation..... 62

CHAPTER X.

How to retain Animal Heat.—Object of Clothing.—Good and Bad Conductors.—Winter Clothing.—Proper Clothing in Moist Weather..... 68

CHAPTER XI.

Natural Moisture.—Overcoats.—Adaptation of Clothing to Weather.—The Duke of Wellington and his Wardrobe.—Fires and Furnaces.—Their Dangers. 75

CHAPTER XII.

Hardening.—Foolish Dread of Cold Air.—Colds: how caught and avoided.—Imprudence of Boys and Girls.—Petting Colds.—Dr. Solander in the Arctic Region.—Chilblains and Frost-bites..... 82

CHAPTER XIII.

Summer Dress.—Cooling Processes.—Head-coverings.—Franklin's Experiment.—Effect of Color..... 89

CHAPTER XIV.

A Philosopher in an Oven.—The Transpiration.—How a Hot Climate is endured.—Whites and Blacks.—Innocence of the Sun.—Sunstroke.—Its Treatment.—Light.—Effect upon Health and Life..... 96

CHAPTER XV.

Rarity of Good Water.—Pure Water of Nature.—How polluted by Man.....*Page* 103

CHAPTER XVI.

Poisoned Water.—Diffusion of Cholera and Typhoid Fever.—Germs.—Death and the Dairy-man 109

CHAPTER XVII.

The Necessity of Water.—Prejudice against Water as a Drink.—Dangerous Substitutes.—Deceptive Look and Taste of Water.—Precautions to be taken in drinking Water.—Suitable Beverage for the Young..... 115

CHAPTER XVIII.

Digestion.—Mastication.—Teeth.—Use and Abuse. 122

CHAPTER XIX.

Saliva.—Use and Abuse of Taste.—Swallowing.—Its Dangers.—Mr. Brunel's Escape.—Remedies for Choking..... 129

CHAPTER XX.

Action of the Stomach on Food.—Effect of Activity of Body and Mind.—Chyme..... 136

CHAPTER XXI.

Beaumont's Experiments.—Comparative Digestibility of Different Food.—Variety.—Feeding Children.—Proper Diet for them..... 145

CHAPTER XXII.

Children's Likes and Dislikes.—Idiosyncrasies.—Variety Essential to Children.—The Child's Table. 151

CHAPTER XXIII.

Regularity in Eating.—Proper Hours for Meals.—Before, at, and after Meals.—Dangers of Careless Children..... 158

CHAPTER XXIV.

The Muscles.—Their Nature and Action.—Exercise.—
Its Effect on the Muscles.—Muscular and Fat People.—Cure for Fat.....*Page* 164

CHAPTER XXV.

Natural Exercise.—Checks of Gentility, Dress, and
Fashion.—Precocious Fine Ladies and Dandies. 171

CHAPTER XXVI.

Formal Exercise.—Long Walks.—Skating.—Swim-
ming.—Riding..... 178

CHAPTER XXVII.

Postures. — Standing. — Sitting. — Lying Down. —
Sleep..... 186

CHAPTER XXVIII.

The Five Senses: The Eye; Ear; Nose; Taste; Touch.
—Use and Abuse of Organs..... 193

CHAPTER XXIX.

The Skin.—Perspiring Apparatus.—Cleanliness.—
Nails.—Hair..... 203

CHAPTER XXX.

Accidents. — Falls. — Cuts. — Bruises. — Fractures. —
Bleedings, etc..... 209

APPENDIX 217



THE YOUTH'S HEALTH-BOOK.

INTRODUCTION.

YOUNG as well as old people should know that most of the worst diseases which torment life, and frequently cause death, may be prevented by themselves. Children in the full glow of health think of illness, if they think of it at all, as a something, no doubt, very disagreeable to have, but about which they need not trouble themselves until it comes to trouble them. Having full confidence in their parents and the family medicine-chest, with the doctor and the apothecary ready to aid in any emergency, future disease has little terror for the youthful imagination. With the indifference to all forebodings of ill habitual to youth, with its absorbing interest in present enjoyment—children are ordinarily reckless of any effect which their own conduct may have upon

their health. They can, however, and ought to be made to, understand that it depends greatly upon themselves whether they are to be strong and hearty, or weak and miserable, or, in fact, to live or die. The preservation of their health should be inculcated upon them as a moral duty; for their usefulness in the world, and therefore the fulfilment of the great purpose of their creation, will depend upon it.

Those who are practised in the training of children know well that they are not to be taught their duty by the mere statement, however impressively made and frequently repeated, of their moral obligations. The child requires to have pointed out to him what to do in each particular case, and to precept upon precept should be added demonstration upon demonstration, until he acquires not only the familiarity of knowledge, but the habit of action. This is the motive of this little book, in which it will be shown how the child should act in his daily conduct so as to enjoy health and prolong life. With this purpose in view, the directions will be given with minuteness of detail and simplicity of language; and though the technicalities of science be avoided, its principles shall be carefully regarded.

CHAPTER I.

Air.—Its Necessity to Life.—Fatal Consequences of Disregard of this Fact.—Bad Habit of Children.—Dangerous Amusements.

CHILDREN hardly need be told that, as soon as they are born, they are brought into relation or connection with a world upon which, or the things it contains, their lives depend. The air they breathe, the food and drink they consume, the clothes they wear, the objects upon which they exercise their senses—touch, sight, taste, smell, and hearing—and the thoughts of their minds, as well as the sentiments of their hearts, are derived directly from the world, or made conscious to them only by being brought into it. These are all necessary to bare existence, or essential to their usefulness and happiness as human beings. Some are supplied by nature ready for use at once, but most require to be prepared by art before they can serve the purposes of civilized man.

The air which covers all this round earth,

extending from its surface to a height above our heads of more than forty miles, is found almost everywhere in a fit state for immediate service. The babe, as soon as born, has nothing to do but open its mouth in crying, which is its first act, in order to get air enough for breathing, without which, as we all know, there cannot be life. Nurses, it is true, who have a wonderful opinion of their own importance, and seem to think that their aid is essential not only to the creature, but to the Creator, will often insist upon having a share in his work. They thus, in their hurry to do something, will begin their operations upon baby with a vigorous spanking, and the little being's first impression of this world comes from the heavy hand of the oppressor. The nurse is conscious that the cry of the infant is good for it in some way, though she is ignorant in what. She probably supposes that, like a noisy squall at a christening, it somehow brings luck. Her rude interference with nature, however, is cruel and unnecessary. If with more patience and less inclination to intrude her busy finger, she waited a little, she would find that baby, requiring no spanking at her rough hand, but merely the gentle touch of the soft air, would soon give

a volley of cries loud enough not only to satisfy the demands of fortune, but the more essential ones of nature.

The first as the last effort of life is a gasp for air; and if it fails, death is the consequence. The absolute necessity of air to the existence of all living beings is a fact no one will be inclined to deny. There are, however, many people who act as if they did not believe it, and daily do a great deal of mischief, not only to themselves, but to others, by their disregard of this simple and most important truth. A mother, during the winter, starting on a sleigh-ride of some distance, and carrying her baby (a few months old) with her, wrapped it up so closely in shawls and furs, and hugged it so tightly, lest its tenderness should be touched by the biting frost, that at the end of the journey, on opening the carefully guarded envelope, she found that it contained a—corpse! Infants are not seldom smothered to death at their mothers' breast, and thus the tenderest instinct of love becomes the cause of a deed of slaughter which no woman would be supposed to be ignorant or stupid enough not to have prevented.

It seems less surprising that thoughtless children should be so foolish or careless as

often to deprive themselves of the quantity of air necessary to freedom of breathing, and do a serious injury to their health, and sometimes even endanger their lives. Thus they are not seldom seen to smother themselves in bed of a cold night, with their bodies huddled up and blankets and coverlets drawn tightly over their heads, so that they may be heated by their own warm breathing and guarded from the least touch of the chilly air. They, no doubt, on the first leap into bed, get a quicker sense of heat (very pleasing in frosty weather) by thus wrapping themselves up, and shutting out all the cold air, but they greatly hinder their breathing, which should be as free during sleep as when they are awake. They certainly, also, injure their health by thus burying themselves in their beds and bed-coverings; and worse consequences, even death, would often result from this bad habit, were it not that in most cases a feeling of oppression forces the little simpletons, in spite of their own resolutions, to wriggle out of their self-made tombs, and gasp instinctively for fresh air. Children, however, will resist with great obstinacy even the sense of suffocation to avoid the least sensation of cold, and more especially

to escape the exposure of their eyes to the imaginary horrors, so dreaded by the timid, of the surrounding darkness. Their resolution, moreover, is unfortunately often able, after a certain persistence of effort, to overcome the oppressive feeling caused by difficult breathing. When they thus resist, as they may do, the first sense of oppression and the instinctive struggle for air, there comes a relief, but one full of danger. It is that of stupor, which in any degree is very hurtful to the health, and, if deep and long-continued, may cause death. It may well be believed that this habit is frequently the cause of those headaches, nervous troubles, and diseases of the brain with which so many young people are afflicted.

In their amusements, too, children are often forgetful that air is essential to health and life. Boys have been known in their mischievous playfulness to heap upon a not unwilling comrade such a quantity of hay, and to sit down upon it (all in the best humor and with the most innocent intentions in the world) so firmly as to stifle every cry and struggle of the victim, until finally he has been drawn out a livid corpse. Another mode of smothering with which the rude child is wont to exercise his cruel humor is

to hold his hands, or put his handkerchief over the nose and mouth of a comrade, and stop his breathing. The struggle in such a case is generally so vigorous that the tormentor, however big and strong, is seldom able to keep his hold very long, and the victim ordinarily frees himself in time for a saving breath of air. His suffering, however, is unmistakably clear in the convulsive agitation of his whole body and the livid face suffused with black blood.

Questions.—What is said about the relation of human beings, at birth, to the world? What is the extent of the air, or the atmosphere of the earth? Is air necessary to life? Give some illustrations of the dangers of forgetting the fact of the necessity of air to life.

CHAPTER II.

The Quantity of Air required.—Two Modes of Suffocation.—Examples.—Stifled in School-rooms.—The Black Hole of Calcutta.

EVERY one requires a great deal of air, and the child as much as the grown-up person. It has been calculated that the proper quantity for a human being each day of twenty-four hours would measure three hun-

dred and sixty cubic feet. This would fill more than nine thousand quart pots, and weigh twenty-three pounds, which he wants every day and night, so that in a year he must have more than three million two hundred and eighty-five thousand quarts, or, in weight, eight thousand three hundred and eighty-five pounds of air. If he does not get all this, he suffers; and if deprived of it for some time, or of a good deal of it for any time, he will die. It does not matter, of course, how he is prevented from having the quantity he wants—whether he has not the air to breathe, as if, for example, he should be shut up in a close box, like the poor girl in the ballad of “The Mistletoe Bough:”

“Oh, sad was her fate! In sportive jest,
She had hid from her lord in the old oak chest;
It closed with a spring, and her bridal bloom
Lay withering there in a living tomb.”

Whether any one is thus shut up in a place where there is little or no air, or he is prevented from breathing it where it may be in the greatest abundance, as was Desdemona by the jealous and cruel Othello, who suffocated her, while in bed, by holding a pillow over her mouth and nostrils, the result is the same—death.

It is not often that people are kept from

breathing by being deprived of the use of their mouths, noses, and lungs through violence, or in any other way; but it is a very common thing for them, notwithstanding the forty miles' thickness of air which surrounds the earth and penetrates almost everywhere, to forego the use of it in such quantities as are required for health's sake. If children are deprived of sufficient air, as they often are in the school, bed, and other rooms to which they are confined, it is ordinarily the fault of the older folk who have charge of them. They are, unfortunately, thus at the mercy of the ignorance or negligence of the guardians to whom they may be subjected. They themselves, however, can do a great deal for their own relief, in spite of the folly and recklessness of those who ought not to be so stupid or careless as to make it necessary. All boys and girls are advised to leave the school-room as soon as they have finished their lessons, and never remain in it to play, as they often do. If, however, the weather or peremptory order keeps them within-doors, then let them by all means open the windows, or ventilators, if by chance there should be any such useful contrivances, that they may romp, and pull, and toss, and tumble at their will,

without the danger of being stifled to death for want of air, which they consume faster and faster as they are more and more crowded together and active in exercise.

Let them take warning from the horrors of the Black Hole of Calcutta, a small prison-house, in which Surajah Dowlah, the cruel Indian ruler of Bengal, thrust, one night, a hundred and fifty English prisoners. In the morning, only twenty-three remained alive, the rest having been suffocated to death by the closeness and narrowness of the dungeon, in which there was no room to move and no air to breathe. This atrocity, which was committed more than a hundred years ago, and dreadfully avenged on the battle-field of Plassey by Lord Clive, is still fresh in the memories of Englishmen, and it would be well for Americans to fix it in their minds as an illustration of the necessity of air and space for living beings.

Questions.—What is the quantity of air required by each human being? Does it matter in what way he is deprived of it? What is the danger of close and crowded rooms? What is the history of the Black Hole of Calcutta?

CHAPTER III.

Importance of the Quality of Air.—Composition of the Atmosphere.—Oxygen.—Carbonic Acid Gas.—Its Dangers and Benefits.—Medicinal Springs.

HUMAN beings require not only air abundant in quantity, but of a peculiar quality. It must be composed or made up of certain constituents or parts, and in proportions fixed within certain limits, or it will not be in a proper state to breathe. If it is not thus composed, it will certainly injure the health of those persons who attempt to live in it, and destroy their lives, sooner or later.

The principal parts of the air or atmosphere are the two gases termed “nitrogen” and “oxygen.”* The former of these is an important element of creation; but the latter (oxygen) is absolutely necessary to the

* The oxygen of the atmosphere, when in a highly electrified condition, is termed “ozone,” and in this state is supposed to have its power of supporting life increased. The wholesomeness of the air may consequently be regarded as dependent, to a great degree, upon its ozone.

breath of life, and is thus often called "vital air." It, however, unless mixed, as it is ordinarily in the atmosphere, with other gases and vapors, is too strong for continued breathing, and would, if not thus diluted, soon cause death.

Besides oxygen and nitrogen, air properly constituted for breathing—pure air, as it is commonly termed—always contains a quantity, in varying proportions, of carbonic acid gas. This acts as a most deadly poison upon living beings when breathed alone, or even mixed with the other parts of the atmosphere, in a larger proportion than is natural and proper. No air can be safely breathed by human beings which contains a larger proportion of carbonic acid than one volume in a thousand. Its deadly action when unmixed is shown by the effect of charcoal burning in a tightly closed room containing a living creature, which, however, he soon ceases to be. The coal (called by chemists "carbon"), in burning, unites with the oxygen of the air, and forms carbonic acid gas. This process goes on until all the vital element of the atmosphere of the shut-up apartment, with the consumption of the fire and the breathing of the occupant, is exhausted, and nothing is left but the deadly

gas. Life being impossible under such circumstances, death, of course, ensues.

Many people, conscious of the effect upon life of burning charcoal in a closed room, have sought this sure mode of getting rid of it. More, however, in their ignorance, have met with the same fatal result upon lighting the deadly fire, and shutting themselves up with it, only with a view to warmth and comfort. Ordinary stoves burning either wood or coal of any kind, or even full gas-lights, where the apartment happens to be small and tightly closed, are hardly less dangerous. It may, indeed, be truly said that no one can remain safely for a long time, and certainly not sleep, in any enclosure containing a fire or light, and into which the outward air cannot enter more or less freely.

The carbonic acid gas which is so fatal, if breathed, seems, curiously enough, very innocent when taken into the body in other ways. In fact, it is positively wholesome, as when, for example, it is swallowed in combination or union with various drinks used as medicine or beverage. The sparkling liveliness of champagne, and of beer and cider, is due to the carbonic acid gas, which is produced in them in the course

of fermentation, while the effervescence of soda-water comes from the same pumped into it. For this purpose, the carbonic acid gas is obtained by pouring oil of vitriol (sulphuric acid) upon powdered marble. The marble is known by chemists as carbonate of lime, which is composed of lime and carbonic acid. As soon as the vitriol touches the marble, it takes away the lime and sets free the carbonic acid gas, which rises like steam or vapor from boiling liquids, and being collected, is then passed into bottles, other vessels, or fountains containing water, which thus becomes that sparkling and agreeable beverage known as soda-water.

Carbonic acid gas is contained in a great many natural springs, and renders their waters not only more pleasant, but wholesome to drink. Saratoga and other medicinal waters of our country, as well as the Seltzer, Vichy, and a great many besides of foreign lands, contain a considerable portion of carbonic acid gas, without which they could hardly be drunk, as they would be too disagreeable to the taste, even if they remained equally wholesome, which is doubtful. The water which we ordinarily drink, moreover, must have some of this gas, or it will not be palatable.

Questions.—Is the quality of the air important? What are the principal parts of the air or atmosphere? What is oxygen? What other name is sometimes given to it? What gas besides oxygen and nitrogen does the atmosphere always contain? What is the smallest proportion of carbonic acid gas that air fit to be breathed should contain? What is the nature of carbonic acid gas? How does carbonic acid gas affect the air? State some of the ordinary means by which carbonic acid gas is produced, and the dangers that result therefrom. Is carbonic acid gas always dangerous? How do the chemists make carbonic acid gas? Is carbonic acid gas found in nature?

CHAPTER IV.

Carbonic Acid Gas in Nature.—The Dog's Grotto.—Carbonic Acid in Wells.—Dangers: how avoided.—Remedies for Poisoning by Carbonic Acid.—Effect of Plants on Carbonic Acid.

ALTHOUGH nature supplies such an abundance of pure air, or what is fit for human beings to breathe, it also, in some comparatively few places, produces various vapors and gases, which no one could take into his lungs without danger certainly, and probably a fatal result, to life. Carbonic acid gas is one of the most common of these natural products, as is clear from its being so

generally found in the medicinal springs abounding in many countries.

There was a spot in Italy, visited not many years ago by most travellers, called the *Grotto del Cane*, or Dog's Grotto, where it was customary for the guide or attendant to make a cruel show of the poisonous power of the carbonic acid gas which nature supplied there in much abundance and of great intensity. He had a dog or some other living animal, which, on the payment of a small fee, he would let down by a rope to the bottom of a chasm or crevice and pull up again, now either quite dead, or with so little life as to appear so. If the operation were performed with sufficient quickness, there would be animation enough left to save the poor beast from immediate death, and it might revive on being brought into the pure air. This was generally the case, and the miserable victim of the experiment was plunged in, and pulled out, again and again, wriggling like a worm at the end of a fisherman's line, and thus for many times in succession suffocated with carbonic acid gas and revived with air, until the curiosity of the spectator and the cupidity of the exhibitor were fully satisfied. The animal was now allowed to recover from the effect

of the poison and take what enjoyment it might, in its brief interval of life, until another tourist, with ready fee and malicious inquisitiveness, renewed the daily torture of the wretched victim. What with Humane Societies, Societies for the Prevention of Cruelty to Animals, and Mr. Bergh, little is heard nowadays of the Grotto del Cane; but not many years since there was hardly a traveller on the continent of Europe who had not his wonders to relate of its dog-smothering; and in the books of travel and even the geographies prepared for the young, it was not uncommon to see the representation of a poor beast at the end of a rope, dangled by a bandit-like Italian, in the eyes of a gaping tourist, supposed to belong to some Christian country or other. The fact is worth recording, not only as an illustration of the deadly effects of carbonic acid gas, but of the cruelty to which a thoughtless and insatiate curiosity will occasionally lead people who call themselves civilized.

There are other places in the world, no doubt, similar to the Dog's Grotto, but where, it is hoped, the like cruelty is not practised. The carbonic acid gas, from its greater weight than the air of the atmosphere, will often collect and remain in crev-

ices, caverns, and deep holes of all kinds. It is apt to gather at the bottom of old wells; and if these are descended incautiously, as they often are by persons ignorant of the consequences, they will be certainly poisoned, and probably instantly killed. Even people of ordinary experience, without the least pretense to a knowledge of science, will not enter a well of any kind, for whatever purpose, without first testing its safety for descent by letting down into it a lighted candle. If this continues to burn, it is regarded as safe; if not, as exceedingly dangerous to descend. The candle test is a good one, the action of which is easily explained. Carbonic acid gas, the chemical philosopher terms a non-supporter of combustion; in plain words, no burning thing, when put into it, will continue to burn. So, when a lighted candle is let down to the bottom of a well, and it goes out, it is presumed that it contains carbonic acid in sufficient quantity to be dangerous to life; for if there is enough to extinguish the one, there will be probably enough to extinguish the other; for neither can long exist in any atmosphere which is composed entirely or in a large proportion of this gas.

Venturesome children, who are generally

ready to put their little noses into every hole, nook, and corner, should be on their guard lest they plunge them into this dangerous carbonic acid gas. If they do, they may not be able to get them out again, for it acts immediately, and produces a quick stupor which will take away from them all inclination to help themselves, and power to do so, and they will probably die like poisoned rats in their holes. Should any child by an ill-chance get into any hole, den, or crevice, and linger long or keep a lengthened silence, his comrades, if they should luckily be at hand, must take what means they may have to pull him out again at once, for it is possible that he has been suffocated with carbonic acid. In case, on being drawn out, he should be insensible, he must be exposed freely to the air, and have cold water dashed into his face, for these are the best remedies for the ill effects of this dangerous gas.

There would be undoubtedly a great deal more danger from the carbonic acid produced by nature were it not that much of it is used for its own purposes as soon as made. By a beautiful provision, this gas, so poisonous to man and other animals, becomes a source of health and vigor to the vegetable

world. Trees, bushes, and plants of all kind, so far from taking harm from carbonic acid, derive from it what is essential to their existence. They breathe in the gas, and, by means of a power within themselves, separate it into its two parts, keeping the carbon which forms the chief portion of their substance for their own use, and giving out the oxygen, so necessary to animal life. Thus vegetables purify the atmosphere.

It is true that during the night plants give out carbonic acid; but this is much less than they take in during the day, being only the superfluous quantity which they have been unable to use, and which is very small in comparison with that daily consumed by them. From the fact, however, a useful lesson can be learned. Never pass the evening or sleep during the night in a close room containing growing plants, for the carbonic acid gas they give out at those times, though small in quantity, may be injurious to health.

Questions.—Is carbonic acid gas an abundant natural product? State what you know about the *Grotto del Cane*, or Dog's Grotto. What is the danger of descending into a well? How can this danger be detected before descent? Explain the lighted-candle test. How do plants purify the air? Do plants ever corrupt the atmosphere?

CHAPTER V.

Carbonic Acid produced by Man.—Respiration.—Purpose of Inspiration.—Purpose of Expiration.—Pure Air the Antidote to Carbonic Acid.—Penetrating Power of Air.—Resistance of Man.—Ventilators.—Summer and Winter Ventilation.

THERE is another source of carbonic acid, and this is ourselves, as well as every other animal which lives. The poisonous gas produced in this way is much more injurious to the health and destructive of the life of human beings than all the rest, whatever may be its quantity, that exists in the whole world. Not because the carbonic acid thus generated acts with a worse effect upon the bodies of those persons exposed to its dangerous power. The gas produced by man and other animals is the same as that found in the Dog's Grotto, in certain natural caves, crevices, holes, and at the bottom of wells, and exercises its harmful and deadly influence in exactly the same manner. The carbonic acid gas from living beings is so much more fatal to their health and lives only because they are more constantly exposed to

its ill effects. Whether alone or with others, in motion or at rest, awake or asleep, or in whatever condition of life the living creature may be, he is a constant producer of this gas. He cannot breathe without exhaling it. One of the chief purposes, in fact, of breathing is to get rid of it.

It must not be forgotten that carbonic acid is composed of carbon, or charcoal, and oxygen. Breathing consists of two processes, performed in man by means of the lungs and chest—one called inspiration, or breathing in; and the other, expiration, or breathing out. When we breathe in, or inspire, pure air (which we ought always to do if possible), we take in principally a supply of oxygen, which is essential to life. When, on the contrary, we breathe out, or expire, we throw off carbonic acid, a gas, as we now know, very injurious in certain proportions, and often fatal to life. The text-book on Physiology, which is, or ought to be, in the hands of all young people, will teach them more minutely than is proper here by what means and for what purpose respiration, the name given to the two processes of inspiration and expiration, is performed. It is enough, just now, to know that the oxygen of the air that is breathed in is mostly used

in the body for heating it, and purifying the blood, and this can only be done by taking the carbon it finds there and burning it, which, in fact, means no more than uniting with it and forming carbonic acid gas. This, being produced in the body—and of no use there—is breathed out, or expired. Thus it is that every living being may be truly said to be a source of poison.

Human creatures being constant generators of a gas poisonous to themselves as well as to others, it would be impossible to live in society, or even alone, if nature did not supply an effectual antidote. This is simply an ever-renewed abundance of pure air, as it is ordinarily called, and which means an air composed of such parts and in such proportions as are best fitted for living beings to breathe, and continue to exist in without injury to health and destruction of life.

Simple as the antidote seems to be, and abundant as it is (being much the largest portion of the forty-mile-thick coat of atmosphere which covers this great globe), many people would seem to be either ignorant of its necessity, or too indolent to get it, although they need do no more than open the window to a crack, or put the door ajar, in order to have all that may be required.

It will now be understood that what is called pure air is wanted by living beings for two purposes, each of which is absolutely necessary to life: one, that they may get the oxygen which it contains; and the other, that they may be freed from the danger of the carbonic acid gas they themselves produce. The first they must have, or they cannot live; and the second they must get rid of, or it will surely kill them.

This pure air, which acts so beneficent a part—giving us life, on the one hand, and warding off death, on the other—is treated as if it were the greatest enemy of the human race. People fasten down their windows, and shut close their doors against it, and seem determined that it shall not enter their houses. Fortunately, however, for mankind—and, in fact, all animal kind subject to the tender mercies of human beings—the air will not stay out, but makes its way in, in spite of bars and bolts, and all the other contrivances which ingenuity, in the service of ignorance and obstinacy, can devise for excluding it. Such is the penetrating power of air, that it will pass through walls of not only brick and mortar, but even of stone; and there are, moreover, always providential cracks, crevices, and holes of

some kind, through which it will gain a more or less free entrance. So, with all the efforts to smother ourselves to death in our boxed-up houses, fortunately it is not easy to do so.

Without being absolutely able to kill ourselves outright in this way, we can, however, and ordinarily do, do a great deal of mischief to our health. Those who build the houses are much to blame, but those who live in them much more so. No building which is to be occupied by living beings ought to be regarded as complete without ventilators, as those contrivances for letting in the pure air from without, and letting out the foul air from within, are called. Even if these are not provided, no one need, if he has a window or a door in his house, be deprived of all the air required, for he has but to raise the one and open the other to get it. People are unnecessarily frightened at what they call a draught, which term they will apply to a breath of air so gentle that it would hardly stir a rose-leaf. Many more are injured by too little rather than too much air.

When there are no ventilators properly constructed, it is not safe for one human being, and much less for more, to remain

either during the day or night in a room with shut doors and windows, without apparent communication with the atmosphere without. If there is an open fireplace, with a free vent through a broad chimney, and a fire burning, there may be no necessity for opening the door or windows, for this itself is a very good ventilator. In winter, when the house is kept well-heated, there is always a freer ventilation than in summer; for in the former case there is generally a draught from the colder atmosphere without to the warmer within, while in the latter it is reversed, if there should be any; but there is generally a complete stagnation of air. In summer, then, especially, the freest communication must be kept up, by open windows, doors, or some other means, with the external atmosphere, or we shall be smothered for want of oxygen to breathe, or poisoned by the abundance of carbonic acid we generate.

Children have little to say or do as to the management of the houses they live in, and must necessarily be more or less at the mercy of the ignorance or negligence of those who may have charge of them; but as they, in their turn, when they become older, will probably have the care, not only of them-

selves, but of others, it is well that they should learn, from the earliest age even, the proper mode of conducting a dwelling. The principles, moreover, which are to guide them in future may also be of immediate service to their daily life in the present. Bearing in mind that they cannot keep their health and preserve their lives if they do not get plenty of pure air, both to supply the life-giving oxygen which they breathe in, and to destroy the effect of the death-dealing carbonic acid which they breathe out, they will surely not crowd together and shut themselves up in any close place, where they cannot but suffer seriously, and may perhaps lose their lives from suffocation or poisoning.

Questions.—What is the most dangerous source of carbonic acid gas? Why is the carbonic acid gas produced by ourselves the most dangerous? Of what two processes does breathing consist? What is effected by inspiration and what by expiration? What is the great antidote to the poison of carbonic acid gas? Is it easy for people to keep the air out of their houses? How is it that it is not so? What are ventilators?

CHAPTER VI.

Atmospheric Impurities.—The Suffocation of the Elder Pliny.—Herculaneum and Pompeii.—Miasm.—Fever and Ague.—Poisons from the Household.—Poisons of Cities: Smoke; Dust; Gas.

THE atmosphere is often made impure or unfit for human beings and most animals to breathe by other causes than the want of oxygen and the presence of carbonic acid. Some of these originate in nature, but more of them are due to man himself.

In volcanic regions, in mines, and other places where the chemical operations of nature, as they may be called, which are constantly going on in the interior and below the surface of the earth, are brought either by artificial or natural means into communication with the external atmosphere, various gases and vapors are set free. These often prove injurious to the health and destructive of the life of man, whenever he may be exposed to them. During the great eruption of Mount Vesuvius which destroyed Herculaneum and Pompeii, nearly eighteen hundred years ago, more lives were destroyed

by the poisonous gases which issued from the burning mountain than by the floods of hot lava and the volcanic showers, which poured down such enormous quantities of ashes and masses of pumice-stone as to bury those beautiful cities so deeply that no trace of their ruins was observed for 1000 years.

The younger Pliny, as he is called, barely escaping, with his mother, from the doomed cities, lived to record the death, on that occasion, of his less fortunate uncle, the elder Pliny, a famous Roman writer on natural history, and a distinguished naval officer. The nephew, in a charming letter, written when he was only eighteen years old, thus describes the fatal occurrence :

“ On the 24th of August, A.D. 79, shortly after twelve o'clock, an immense cloud was observed to rise over the mountain, in the form of a pine-tree—partly of a white, partly of a dark color, which came from the ashes it carried with it. The elder Pliny went with several galleys to the assistance of those whose villas were situated at the foot of Mount Vesuvius. As he approached the shore, the cinders, which grew thicker and hotter, fell into the ships, together with pieces of pumice and some larger stones. At length the shallowness of the water pre-

vented him from landing, as the sea had retreated from the shore. A strong north-west wind had sprung up, which drove him to Stabiæ, about three miles distant from Pompeii. The falling of ashes and punice continued the whole night, and grew more and more violent. Several large streams of lava broke forth from the mountain, and Pliny was obliged to resolve upon leaving the house in Stabiæ, to avoid being overwhelmed by the showers of stones and ashes.

“They went out, having large pillows tied upon their heads, as a protection in the open air. It was on the 25th of August, in the morning, and the eruption continued to increase, and at last reached such a height that a most fearful explosion took place, during which the stream of lava was emitted which entirely overwhelmed Herculaneum. This explosion drove the followers of Pliny to flight; but as he was stout and short of breath, he instantly fell down dead, being suffocated by some gross and noxious vapor.”

The total number of persons killed by the destruction of Herculaneum and Pompeii is estimated at 1500; of these the greater part were suffocated, as they sought refuge, in the interior of their houses.

Many thousands lose their lives every

year in the English mines, by being suffocated or blown up with choke-damp, or other explosive and poisonous gases.

There is another abounding impurity of the atmosphere and great source of ill to man—a product, it is true, of nature, but which lies in the power of human beings to avoid or remove. This is what is called “miasm,” from a Greek word meaning to infect; or “malaria,” which merely signifies bad air. It arises from damp places, ponds, swamps, streams, and rivers, and is supposed to be produced by the decay of vegetable matter of every kind when acted upon by heat and moisture. Its exact nature is not known, but its effect, unfortunately, is very familiar to many people, especially of our own country. It prevails mostly in newly occupied regions, which have not yet been thoroughly cultivated. It disappears generally in the United States with the increase of the number of inhabitants and the full development of the habits of civilization. The clearing of the land and its drainage seem to be the surest means of preventing the generation of miasm. It still prevails, however, in some of the oldest countries, as in the Pontine marshes of Italy, in the neighborhood of Rome, and which so infects

its atmosphere that a residence at certain periods of the year in that famous city is excessively dangerous to most strangers.

The most familiar result of breathing this miasm is the fever and ague, to which habit has so familiarized many of our outlying fellow-citizens, that they make quite light of it, and when condoled with on the score of their sufferings from the disease, and the cadaverous looks which it gives, they will answer as firmly as their bloodless and trembling lips will allow, "It is only the shakes." The fever and ague, however, though its fits are possibly not difficult, with long practice, to endure, is a serious disease, inasmuch as frequent attacks will greatly weaken the strongest constitution, and often do permanent injury to some of the vital organs of the body.

Where miasm prevails, the best means of avoiding its ill effects is to keep up good fires in the house during the spring and fall, or autumn—for these are the seasons when it abounds—even though the cold is not sufficiently great to seem to require them. It is prudent, moreover, to keep away, particularly in the early morning and during every hour of the night, from all rivers, creeks, ponds, and marshes, which generate

the miasmatic poison. Old and experienced people are generally wise enough to do so, but young folk are very apt to neglect this and every other precaution against danger to health. Children should hurry away from the river, stream, or pond, in which they delight to sport, and not linger about their banks or borders; and, as soon as the sun sets, they should try to get under the snug cover and within the comfortable warmth of home before the miasm begins to infect the atmosphere. This will be particularly necessary if they happen to have a wet jacket or wet boots or shoes (which they ordinarily do, if there be any possible means of getting them), since the least chill from cold and moisture will make them more liable to catch the fever and ague, or any other disease caused by malaria.

The air we breathe is more or less poisoned by the daily work necessary in every household, shop, and factory. There is not a fire or light burning which does not send out a poisonous vapor or gas. In England a law forces every proprietor of a large furnace or manufactory to use a contrivance for the consumption of the smoke that may be produced in the course of the operations carried on in those establishments. Such a

law should be made in every country; and it would be wise, if it were practicable, to extend it to the smoke raised in private houses, for the atmosphere of whole cities is now infected by its poisonous qualities.

Most cities, and our cities especially, are filled with producers of poisons which we take in with every breath of air. There is not only the smoke which comes out of every chimney of dwelling and factory, but there are also the reeking vapors rising from slaughter-houses, the offal and corruption which are found more or less in every street, and, besides, the polluting breath of the millions of living and of the thousands sick and dying, to make the great city a huge generator of poison.

The very dust which rises from each step taken makes the air less fit to breathe. Persons whose occupations are of such a kind as to expose them daily, for a long time, to various kinds of dust are apt to suffer from a special ailment which soon destroys their lives. Street-sweepers, grinders of glass and metal, coal-heavers, and such-like, are often affected with a disease of the lungs produced by particles of the dust to which their occupation exposes them taken in with the air they have breathed.

These inflame the delicate breathing apparatus, and produce all the dire effects of the fatal consumption. On examining the lungs after death, they are generally seen to be mere dust-heaps, with all their natural substance ulcerated away, to make room for the fatal mass of stuff which has taken its place.

The ordinary dust of the streets, houses, and buildings of all kinds, is not safe to breathe. It is advisable to avoid raising it, and keep out of it if it should be raised. The not uncommon practice of a large number of children romping in dirty school or carpeted rooms is exceedingly dangerous, not only in consequence of the pollution of the air from the breathing, but of the dust raised by the motion of a stirring crowd.

It may be well to remind all people, and especially the young, that the gas used for lighting purposes acts as a deadly poison if breathed. Its odor, fortunately, is very strong, and readily noticed, so that the least escape of gas will attract attention, of those, at least, who may happen to be awake. As soon as the peculiar smell is observed, the safest proceeding is to open the windows at once, and let in as much air, which is the best antidote to the poison, as possible. Beware, however, of taking a lighted candle,

match, or anything, in fact, which is burning, into an enclosed place where gas is suspected to have escaped, or there will be an explosion, still more certain and quick to destroy life.

Questions.—Are the want of oxygen and the presence of carbonic acid gas the only causes of the air being unfit to breathe? How did most of those who were destroyed at Herculaneum and Pompeii lose their lives? Who was the elder Pliny? How and where did he lose his life? What do you understand by *miasm* and *malaria*? What precautions should be taken against their ill effects? How is the air of the house poisoned? How is the air of the streets and cities made impure? What are the dangers of dust? What are the dangers of the gas used for lighting purposes?

CHAPTER VII.

Corruption of Air by Disease.—Contagion and Infection.—Epidemics.—Precautions.—Duty to the Sick.—Hygiene.

HUMAN as well as most other animals, when diseased, are not only corrupting the air constantly, as healthy people, by the carbonic acid gas and other natural products they give forth from various parts of their bodies, but by certain emanations peculiar to their unwholesome condition. People,

whatever may be their ailments, throw off gases and a variety of matter of different kinds, which tend to make the atmosphere poisonous and dangerous to life. There seems, moreover, good reason to suppose that there constantly passes into the air, as well as elsewhere, from those persons affected with certain peculiar diseases, germs or seeds which are capable of producing exactly the same affections in others when, in any way, taken into their bodies. The small-pox, the measles, the scarlet, typhus, and other fevers are believed to be thus often conveyed from one to another, and so sown broadcast through vast multitudes of people.

It is common to speak of contagion and infection as if they were two very different things, and to apply the former to those diseases which are supposed to require actual contact or touch for conveyance from the sick to the well, and the latter to such as are communicated to the healthy through the air or other sources poisoned by what passes, in various ways, from diseased persons. The words are both from the Latin, and mean very much the same thing; that is, "taint by communication." The common distinction made between a contagious and an infectious disease is so far true to the

fact, that the former (called contagious) is more easily conveyed by touch than the latter (called infectious); but either, if communicable in one way, is probably communicable in the other. The small-pox is ordinarily regarded as especially a contagious affection; but, sure almost as it is to be conveyed by touch, it is undoubtedly so, also, through the air and by other means. The typhoid fever, on the other hand, is supposed to be a marked example of an infectious disease conveyed by the air and other media, and yet no one can say that it may not be by contact also. Scarlet fever is an affection which all who know anything about it will allow has both contagious and infectious properties in a high degree.

There is, it must be confessed, a great deal of mystery about the nature of contagion and infection, which it is hoped that science may clear up before long. In the mean time, it is well to bear in mind the fact that the bodies of persons affected by certain diseases are in some way or other giving off a poison which makes it dangerous to come in contact, either directly or indirectly, with what comes from them; and one should take heed not to expose one's self unnecessarily to it.

Certain precautions may be taken by those who attend the sick to prevent what poison they produce from injuring the healthy. Plenty of pure air must be allowed to enter the sick-room, the greatest cleanliness kept, all which passes from the patient disinfected, as it is called—that is, deprived of its poisonous quality by certain substances known as disinfectants—and carefully removed from all possible chance of contact in any way with living creatures, and no person whose attendance is not absolutely necessary admitted into the same apartment with the diseased person.

Prudence, however, while it suggests care and caution, by no means advises a craven fear. Nothing so disposes a healthy person to catch a contagious or infectious disease as fright. From the East, whence came “The Arabian Nights” and many other pretty stories, in which useful truths are so invitingly arrayed in the attractive dress of fiction, comes this fable: A stranger on the road, accosting the Plague coming out of Bagdad, said, pointing to the city, “You have been doing great havoc there.” “Not so great,” replied the Plague; “I only killed one-third of those who died; the other two-thirds killed themselves with fright.”

While all unnecessary exposure to infection or contagion should be avoided, it ought to be remembered that the best protection against its evil consequences is a courageous spirit. There are, besides, certain precautions which even the bravest need not despise to take, that may perhaps prove useful. It has been found that anything which weakens the strength or depresses the nervous power will predispose to infection or contagion. No excess is safe at any time, but it is almost sure to be fatal when the person who has indulged in it is exposed to the poisonous emanations from the sick. Every one who has occasion to visit a person affected with an infectious or contagious disease should take care not to do it on what is called an empty stomach. He must not be weakened by the cravings of hunger and want of food. It may be well, too, to guard his mouth and nostrils with the breathing apparatus commended by an eminent philosopher* of London, who, holding that contagious and infectious diseases are conveyed from the ill to the well by means of germs, or seeds, floating in the air, supposes that they may be thus stopped on their course to

* Tyndall.

the mouth and lungs, and prevented from poisoning the body. The handkerchief, or some flocks of cotton or wool, will answer the purpose if the more artificial contrivance is not at hand.

When such diseases as have been spoken of, and others like the cholera and plague, fall upon a great number of people at the same time, they are called epidemic, from the two Greek words, *ἐπι*, upon, and *δῆμος*, people. It is during the prevalence of an epidemic that it especially behooves every one to be careful of his general health, to reform such habits as he may have which weaken force and predispose to disease, and avoid excess or imprudence of any kind, such as extraordinary indulgence in eating or drinking, unusual strains of the strength likely to cause much fatigue, and exposure to rough weather, and sudden changes of heat and cold.

Why diseases should prevail sometimes as epidemics and afflict multitudes, while at other times they remain comparatively secluded, and only attack single persons here and there, is still a mystery unsolved by science. It is reasonable to suppose that the fact is owing to some influence of the atmosphere. Hidden, however, from human

knowledge as is the cause of an epidemic, its worst effects are within the power of human wisdom to ward off, to a great extent. By obeying strictly the laws of health, which it is the purpose of this little book to set forth, the worst diseases, come as they may, can be boldly defied. With pure air to breathe, and the other requisites for wholesomeness of living yet to be explained, there need be no great fear of danger. Upon the proper understanding and right direction of the influence of these upon life is based the whole art of health, or hygiene, from *ὑγίεια*, health, as it is called by men of science, which it is the duty of every one, for his own sake and that of his neighbors, thoroughly to learn, and diligently to practise.

There is another mystery connected with the history of contagious and infectious diseases which has perplexed for many ages, and still continues to perplex, the most ingenious and learned men. It is this well-known fact, that a person is not attacked more than once by any of these diseases, as the small-pox, measles, and the scarlet, typhus, and typhoid fevers. This, though a general, is not an absolute law without exceptions; but these are, however, of that rarity which is said to prove a rule. There

are instances recorded, but mentioned as curiosities, by medical writers of persons having had small-pox, and other contagious and infectious diseases, not only twice, but even more times. Sir Robert Christison, a famous professor of the University of Edinburgh, was so peculiarly liable to typhus fever that he was forced to give up his attendance as a physician upon any patient affected by it; for he found, after a series of half a dozen or so attacks, that it was not possible for him to expose himself to the disease without getting it. He thus, although one of the most eminent and indefatigable physicians of the Edinburgh Infirmary, was, after many years of heroic martyrdom to the typhus fever, of which his peculiar sensibility had made him so frequently a suffering victim, forced by his associates to yield to their remonstrances against his entering any ward of the hospital in which there were persons affected by this disease.

Such exceptions, however, are so rare, that those persons who have once had a contagious or infectious disease may presume that they will not get it a second time, and can accordingly, without reasonable fear, attend upon their friends, or other people calling

for their good services, who are afflicted with it.

Questions.—How are diseased persons supposed to corrupt the air? What is said about germs? What are contagion and infection? Mention some contagious and infectious diseases. What precautions should be taken against contagion and infection? Relate the Eastern fable about the effect of fright. What is an epidemic? What is hygiene? Do contagious and infectious diseases attack the same person twice?

CHAPTER VIII.

Animal Heat.—Its Mode of Production.—How regulated.—Necessity of adapting Habits of Life to Climate and Season.

MOST young, and probably old, people have no idea of any heat except that which comes from the sun, fires of all kinds, and, as they suppose, from warm coverings, such as the furs and feathers of animals, and the clothes worn by human beings during the day, and the bed and bedding in which they lie at night. The most important source of heat, however, that upon which comfort not only chiefly depends, but health as well as life, is none of these.

Human beings, and, in fact, all living

creatures, make themselves the heat which is most necessary to them. They are all provided with furnaces, as they may be called, within their bodies, which continue to burn as long as they breathe, and only go out with life. So well regulated, moreover, is this internal fire, that to whatever degree of cold the external parts of his body may be exposed, the living being, if provided with the ordinary essentials to healthful life, continues to get within himself all the heat he requires. So that whether his skin is scorched by the blazing sun of the tropics, or shrinks from the withering touch of the arctic frost, the internal furnace keeps the interior of the body at nearly the same uniform warmth. He may be gasping, in the one instance, with his tongue thrust out for cool air, or, in the other, fearing almost to open his mouth lest his lips should be barred and tortured with the spikes of frost into which every breath is congealed, and yet, within the teeth, in both there will be hardly any perceptible difference of temperature. The same piece of ice would melt with equal rapidity in the mouth of each.

The internal warmth of the living body, or animal heat, as it is called, is produced and regulated to a considerable extent by

the process of breathing,* of which there has been already a good deal said. This essential process of life consists of two acts—that of inspiration, or breathing in, and expiration, or breathing out. By the former, pure air is taken into the lungs, and the oxygen, or vital gas, which it contains is there brought into contact with the carbon, or charcoal, which is already in the body. The consequence of the two coming together is a combustion, or fire, like any other fire, although taking place under such circumstances that no flame or glow is apparently produced. Heat, however, as of all fires, is the result; and this forms principally what is termed “animal heat,” which warms the interior of the body. By expiration, or breathing out, which immediately follows every act of inspiration, or breathing in, the product of this fire which has been set agoing in the lungs is thrown out of the body in the form, as we know, of the poisonous carbonic acid gas. This may be called the

* There are other combinations, for example, of oxygen with hydrogen, forming water, which bear a part in the formation of the animal heat; but, for the sake of simplicity, the illustration in the text has been confined to the combination of oxygen with carbon in the process of respiration.

smoke of the living furnace, and is, in fact, the same as a great part of what comes from the burning of wood or coal, although in both there is, besides, a good deal of matter of a different kind.

The fuel which supplies the human furnace is obtained chiefly from the food, and is essentially the same substance as is burned in ordinary fires. It is carbon, or charcoal, and comes from the fatty portions of the meat, vegetables, and other articles of food eaten, and the alcoholic fluids of various kinds drunk by man. The animal furnace is supposed to be regulated and adapted to varying climates by means of the action of the body, the air, and diet. In order to keep a uniform temperature, whatever may be the degree of external warmth or cold, it is obviously necessary to vary the quantity of heat produced. In cold climates and cold weather, a greater supply, and in hot climates and hot weather, a less, will be required. In the former, accordingly, a much greater stock of carbon, or charcoal, should be taken in; and as this is found in the largest quantity in fatty food, such would appear to be the most appropriate for cold regions and seasons. This seems to be confirmed by the greater inclination for such

food, under these circumstances, and the apparently instinctive fondness of the Esquimaux and other inhabitants of arctic countries for whale-oil, seal-blubber, tallow-candles, and soap-fat.

To consume the abundant carbon, or fuel, thus supplied—for fat of all kinds, it must be remembered, is chiefly made up of this charcoal—there must be, in order to keep agoing the brisk internal fire required for the large quantity of animal heat necessary to living beings in cold seasons, a great abundance of oxygen. This nature takes care to furnish, by means of the more condensed or closer-packed atmosphere which is found during winter and in arctic regions. A greater quantity of the oxygen, without which the fires in the inside of the body, as in the ordinary ones, will not burn at all, is thus supplied. Cold, moreover, promotes activity, and especially impels to brisk exercise of the body, and consequent greater quickness of breathing. The respiration thus not only becomes more rapid, but at each inspiration the air taken into the lungs contains a larger proportion of oxygen.

In summer and in warm regions, the opposite occurs. The atmosphere is rarer, or less closely packed, and contains in the same

place less oxygen, so that in each inspiration there is a smaller quantity of it breathed into the lungs. The disinclination, moreover, to activity, and the general habit of indolence, which are common to people living in hot climates, and even to the inhabitants of temperate latitudes during the season of summer, cause them to breathe less frequently, and consequently tend, together with the rarer atmosphere, to diminish the supply of oxygen.

The fuel, too, is ordinarily greatly decreased by the kind of food generally preferred and eaten by people during the warm weather, which prevails in the summer of temperate, and in all seasons of tropical, climates. There is an instinctive aversion to most fatty foods of all kinds, which, as we know, contain so much carbon, and a decided preference for fruits and vegetables, which contain, comparatively, so little of this substance. In fact, the inhabitants of many hot climates live almost exclusively on rice, fruits, and other products of a vegetable kind.

There are, however, unfortunately for themselves, a good many foolish people who refuse to yield obedience to the laws of health, set forth so clearly by nature her-

self. These persons first acquire habits of self-indulgence in eating and drinking in a country the cold climate of which would seem to permit as comparatively innocent. They then change it for a tropical region, without altering their mode of living, and continue habitual excesses, which its heat forbids as fatal to health and life.

Thus many an Englishman, bred amidst the chilly fogs of London to beef, pork, and porter, goes to live in India, and persists, while weltering in the sweat of its prevailing heat, in gorging himself with his habitual abundance of solid food and profusion of strong drink. He at the same time is forced by the warmth of the climate to a necessary repose and indolence, and to breathe an atmosphere poorly supplied with oxygen. He thus is taking in constantly a great deal of carbon, or fuel, without being able to get what is essential to burn it. Mark the consequence. The excess of carbon taken into his body not being consumed for want of enough oxygen for the purpose, and therefore not escaping in the usual form of carbonic acid gas from the lungs, is retained within him, and cast, like so much waste matter, into the most convenient receptacle found in his interior. This is or-

dinarily the liver, which thus becomes a garbage-box, as it were, and a very serious nuisance it proves to be to the unhappy possessor; for the waste carbon, which fills it, is changed into an unwholesome greasy matter, which results in the production of a disease known to physicians as the fatty liver of India, which is so fatal to the hard-eating and deep-drinking Englishmen who have lived in that hot Eastern country.

Questions.—Which is the most important source of heat to man? How is the animal heat produced? How is the animal heat affected by diet? How is the uniformity of animal heat kept up in various climates? What are the effects of not adapting the food and mode of life to the climate?

CHAPTER IX.

Evaporation.—Conduction.—Radiation.

WHEN an old sailor wants to know which way the wind blows, he will first put his finger into his mouth, and then hold it up in the air. Wherever it feels coldest, as it does on one side or the other immediately, he concludes that is the direction of the wind. When asked for an explanation, he

will probably, with a great expression of contempt for the landsman who has made the inquiry, gruffly answer, "Why, of course it is the breeze; don't you see, you lubber!" He is indeed right; it is the breeze; but the question is, how does it act?—a question which any one with the least knowledge of chemistry will answer at once, "By means of evaporation." This would be intelligible enough to those persons who had as much or more knowledge of the subject than he himself possessed. The old sailor would probably only exclaim, with another contemptuous growl, "Vaperashun! vaperashun! that's all you lubbers know about it. I tell ye it's the breeze, the breeze—don't ye see?—which blows cold!" Evaporation, however, is, as the man of little or much philosophy agrees to call it, the true cause of the phenomenon. It is the cold which is always produced by the change of a fluid into vapor, a process termed "evaporation," which enables the sailor to tell the direction of the wind. This change from a liquid to a vapor is greatly favored by the abundance and rapid movement of the air; so the moisture of that part of the finger which is exposed most directly to the wind, and consequently receives most air, in the quickest

time, will be the first to evaporate and feel the cold produced, in consequence. Evaporation, under favorable circumstances, will produce cold enough to form ice. Belzoni, the famous traveller, conscious of this fact, undertook, with the utmost confidence, to show the sultan that he could turn water into a solid, notwithstanding he was threatened, if he failed, with the loss of his head. He, of course, succeeded; making use of the now familiar means of an air-pump, in the receiver of which a little water being placed, and a vacuum produced, a film of ice soon made its appearance, much to the surprise of the sultan, who in those days was not familiar with the frozen luxury of the Wenham and Rockland lakes, which the enterprise of our countrymen has since diffused over the whole world. It is usual for the people of warm climates to cool their drinking-water by keeping it in porous earthen jars, or wrapping the vessels which contain it, in moistened cloths, both of which, especially when exposed to a draught of air, favor evaporation, and consequently produce a very considerable cold.

There are two other processes, called by men of science "conduction" and "radiation," by which cold is produced both in liv-

ing beings and lifeless objects; and while this is going on, heat is by the same means conveyed from these to other living beings and lifeless objects; but just now it is the cooling effects only that will be explained.

By *conduction* we are to understand that process by which heat* passes through bodies, living or otherwise; and it is common to call such bodies "good conductors" and "bad conductors," according to the ease and quickness with which they allow of its passage. If any one takes an ordinary pin or bit of wire, and, holding it by one end, puts the other into the flame of a candle, he will soon find it too hot to hold, and be forced to drop it, for the heat will pass almost instantaneously from the blaze to the fingers, and

* When speaking of heat in this little book, it is to be understood in its popular sense, as referring to the effects produced by it on the senses, and not to its definition by science, according to which heat is a form of force; and its various manifestations, of which cold even is one, are only its changes, the nature of which is still in a great degree mysterious to the philosopher, and, of course, does not admit of any successful attempt at explanation to the child. When, with the advancement of years, he reaches the higher studies of chemistry and natural philosophy, the occasion will come for the proper consideration of the subject of heat in its scientific aspects.

burn them. The pin or wire is therefore called a good conductor of heat, or the iron of which it is made—as is, in fact, every metal, whatever form it may have. If, instead of the metallic thing, a bit of paper is held to a flame, it will take fire and burn to the very tips of the fingers without their feeling the least sense of warmth. Paper is therefore called a bad conductor, and a great many substances of different kinds have the same character.

Wood, ivory, cloths, furs, feathers, and other familiar substances, are bad conductors, and, though not generally recognized by this name, are constantly made use of because they have the quality which it expresses. Wooden handles are fixed to the iron poker with which the fire is stirred; a pad of cloth is put on the holder of a flat-iron in ironing clothes; no one attempts to take a boiling pot from the fire with the hand until it is guarded with a cloth of some kind; and the parlor tea-urn would burn the delicate dame who serves it if there were not a bit of ebony, ivory, or some other bad conductor, let in between the handle and the body of the vessel which contains the hissing-hot fluid, to prevent its heat from passing to the fingers that grasp it.

Radiation is the process by which heat passes from a body apparently in *radii*, or rays. *Radius*, which is a Latin word, means the spoke of a wheel, and the arrangement of the spokes of the wheel passing from the centre to the circumference gives a very good idea of the way in which heat seems to pass from a body of any kind. The rude pictures of the sun seen upon sign-boards, where a round flaming head is represented to be darting spikes of fire on all sides, will supply further illustrations of what is meant by the term "radiation." It is by waves, however, that, as we are told by the philosophers, heat passes from body to body; thus the heat of the real sun reaches us; and it is also in this way that we receive the warmth of the stoves, grates, and other contrivances for heating us. The whole earth, and everything upon it, is ceaselessly radiating heat, and thus there is a constant tendency in nature to produce by this means in all objects, living or otherwise, an equality of temperature; but the effort is checked by other processes, such as the evaporation and conduction, of which we have spoken. The greater coldness of the night is due to the larger degree of radiation from the earth of heat, in proportion to what it then re-

ceives from the sun, than during the day. The inhabitants of India make a useful application of this fact. They expose shallow pans filled with water to the night air, so arranged as to favor radiation, and the cold produced is generally sufficient to cover them before morning with films of ice.

Questions.—State the way by which sailors find out the direction of the wind. What is evaporation? What was Belzoni's experiment? What is conduction? Give an illustration of conduction. What is radiation? What is the tendency of the earth and all bodies? How is equality of temperature checked? How is ice produced in India?

CHAPTER X.

How to retain Animal Heat.—Object of Clothing.—
Good and Bad Conductors.—Winter Clothing.—
Proper Clothing in Moist Weather.

DURING cold weather we have, as has been explained, to keep up a brisk internal fire in our bodies. This, we know, is done by taking in a great abundance of carbon, which is furnished by the food we eat, and plenty of oxygen to consume it, which is inhaled with the pure air we breathe. The

quantity of animal heat, however large, thus produced would be of little advantage if it escaped as soon as made. Means must be used not only to keep up a brisk fire within, but to prevent its warmth from leaving the body too rapidly. A certain degree of heat in the interior of our bodies is absolutely essential to health and life. This is generally estimated to be about 100° of Fahrenheit, which is ordinarily marked upon the thermometers used in the United States as "blood-heat." In healthy human beings this should vary but little, whatever the degree of external heat or cold to which they may be exposed; and a thermometer placed in the armpit, or beneath the tongue, of a person during the coldest day of winter or the hottest of summer ought generally to rise to this point of 100° Fahrenheit.

To prevent the animal heat made within the body from escaping too quickly, and to keep it up to the degree essential to its healthy condition, certain familiar means are used. The roof that covers, the walls that enclose us, the clothes we wear, and the fires we light, are mainly for this purpose. All of these act thus beneficially, directly or indirectly, through evaporation, conduction, and radiation; some chiefly by one, and oth-

ers by two or three together of these processes.

The animal body, like all other bodies, has a constant tendency to lose its heat by evaporation, conduction, and radiation ; and if the purpose is to keep it, as of course it is, during cold weather at least, the action of these must be checked.

From what has been already said, it is hardly necessary to repeat that the popular notion that the body receives warmth from the covering put upon it is a mistaken one. The only purpose of dress, apart from satisfying decency and taste, is, in cold weather, to prevent the escape of the heat of our bodies, which is, as has been again and again explained, entirely of our own making.

To keep the heat we make, or, in other words, to prevent it from being led or conducted away, we must cover our bodies with such substances as cannot easily conduct or lead it away. These are what are called "bad conductors." People have been taught by experience to use many of these, and, with little or no philosophy, have contrived to protect and keep themselves tolerably comfortable in cold weather. Few persons need be told that feathers, fur, and wool are warmer than bare skins, cotton, and linen ;

but while they are ignorant of the reasons why they are so, they will not only continue to make mistakes in the use of things familiar to them ; but fail to avail themselves of the advantage of others equally or more beneficial, of which they may happen to have no experience.

To keep the warmth that is in us—as we desire to do, especially in cold weather—we must, then, clothe our bodies in bad conductors, such as feathers, furs, woollen cloths, and flannels. Furs and feathers, though the best for the purpose, being the worst conductors, are too costly for common use, and so articles made of wool are generally used. As the skin of some persons is particularly sensible to the least roughness, the smooth silk, cotton, and even linen, are often preferred to the harsher woollen materials. Of these, linen is a very good conductor, while cotton and silk are tolerably bad conductors, and are therefore preferable to it for winter wear.

The air is a very bad conductor, and the more held by any article of clothing, the less will be its power to conduct away heat. The looser, therefore, the texture of a material, the better will it be adapted for winter wear, since the greater quantity of air which

the spaces between its coarsely woven threads allow it to receive will proportionately lessen its conducting power, whatever may be that of the substance of which it is composed. Cloth of wool or cotton, though these materials are naturally bad conductors, may be made a good conductor by close weaving or fineness of texture. It is probably on this account that fashion has been forced to give up the fine broadcloths, once deemed indispensable for the daily wear of the finer gentleman. He now generally keeps the superfine stuffs for the warm atmosphere of the dining-room or dancing-saloon; though, in compliance with ridiculous tradition, he may yet be seen in the coldest weather freezing in the scant swallow-tail coat and thin trousers of black kersey-mere in the sepulchral church at a wedding, or at the edge of an open grave at a funeral.

The make of a dress, as well as the texture of its material, will greatly affect its conducting power. A tightly fitting garment is much colder than a loosely fitting one; not only, however, because it thus becomes a better conductor by excluding the air, but also in consequence of its pressure upon the body, which prevents the free circulation of the blood, so essential to the fire-

making process going on within us. The loose sack-like suit now generally worn by most of the male sex, boys as well as men, is a sensible concession of fashion to utility, which could hardly be expected from a guide which so often leads the world into absurdity. Women, however, have nothing to thank fashion for on this score, but are still, in accordance with its peremptory orders, squeezed into the narrow bodice, and tortured with the ever-tightening corset. That their noses are nipped by each touch of cold air, and whatever is movable about them should quiver, even while fixed to the fireside, at the faintest breath, is not surprising. No good fire can be made or kept agoing in frames where there are so many obstructions to a free circulation, and warmth, of course, is no more possible than in a stove without a draught. To the torture at all times of the pressure of tight boots, shoes, and gloves, with which the fools of fashion inflict themselves, will be added in winter the suffering from cold hands and feet. The power of holding air will be increased, not only by the looseness of fit of the dress, but by the greater number of its layers. In the winter, accordingly, a person does well to pile coat upon coat, and roll

wrapper around and around, if he is to be exposed to severe cold, without the opportunity of active bodily exercise.

Moisture increases the conducting power of all clothing, since it drives out the air in the spaces between its threads or fibres, and thus takes the place of a worse conductor than itself. Wool absorbs moisture with less rapidity than linen, and its conducting power is therefore not so much increased by it. Whatever may be the season of the year and the temperature, a woollen dress, when exposure to wet cannot be avoided, is the safest to wear, for the heat of the body is thus less likely to be suddenly checked—an occurrence always dangerous to health, and frequently fatal to life.

Questions.—What is understood by “blood-heat?” How is the animal heat preserved? What is the purpose of dress? Mention some bad conductors suitable for dress. Is air a good or bad conductor? How does the texture affect the conduction of articles of dress? How does the make of a dress affect its conducting power? How does moisture affect the conducting power?

. CHAPTER XI.

Natural Moisture.—Overcoats.—Adaptation of Clothing to Weather.—The Duke of Wellington and his Wardrobe.—Fires and Furnaces.—Their Dangers.

THERE is a natural moisture upon the surface of the body of every healthy person, which, like all other moisture, tends to evaporate and produce cold. This, however, is greatly checked by clothing of all kinds, which protects the surface of the body from the movement of the air, which, as has been shown by the explanation of the old sailor's practice of holding up his wetted finger to find how the wind blows, is particularly favorable to evaporation. If the dress, however, should by any chance become wet, its own moisture will continue to evaporate until it is dry, and necessarily produce, in the mean time, a coldness which the person who may wear it is sure to feel. It is thus that a wet jacket or any other article of clothing becomes soon uncomfortable, and, even in the warmest weather, is apt to produce a chill exceedingly dangerous to

health. Young people, therefore, are earnestly urged to give more heed than they usually do to the advice of their parents and others to make haste to change their clothes, whether only damp or soaking wet, as soon as they cease all active exercise, and are about to remain at rest.

The coldness from the natural radiation of the body is also checked by the usual winter clothing, which soon acquiring the warmth of the person it covers, gives back as much heat as it takes in this way. On first putting on, however, the thickest garment—for instance, an overcoat which has been hanging up in a cold hall, while he who is to wear it has been sitting by a blazing fire in a hot room—there is a very evident feeling of chill. The warmer body radiates to the colder coat more heat than it at first receives, and consequently there follows an immediate sensation of coldness.

It is not desirable that young people should habituate themselves from an early age to too much comfort, lest they should become so effeminate as to be incapable of enduring the more or less hardship they are sure to be subjected to in the course of their lives. They can undoubtedly bear the trifling inconvenience of a momentary senso

of the coldness of an overcoat, if they are so fortunate as to have one, while relying on the comfortable assurance of its promised warmth. The fact, however, remains, that the thickest and warmest garment will, under the circumstance mentioned, feel cold, and it is well to note it, for the knowledge may be useful. It is necessary, in case of weakness from illness or a feeble constitution, to guard against all sudden changes of temperature, and, therefore, it will be well to warm each garment by the fire before it is put on, that, on being brought close to the body, it may not take away more heat than it gives. This warming of the clothes, overcoats, and wrappers of all kinds, is also an excellent preparation for a ride or any exposure in excessively cold weather. It will often secure a comfortable warmth, otherwise impossible.

The old Duke of Wellington is said to have had as many varieties of cloaks and overcoats as there are changes of weather. As the climate of England, where he lived, is very variable, the duke's wardrobe must have been as full of odd garments as the shop of a Chatham Street dealer in old clothes. His Grace very sensibly resolved to adapt his dress not only to the change of

season, but to the temperature varying from day to day. Accordingly, every morning, before setting out on his daily ride or walk, his well-known aquiline nose might be seen for a moment at the window just opened to a crack, testing the sensation of the weather, and taking an observation of the thermometer hanging there. He, having thus noted the temperature, would bid his valet bring him the corresponding covering. Now it would be the freezing-point fur cloak, now the forty-degree cloth coat, again the temperate light military cape, and so on through all the range of the thermometer and the wardrobe.

Every one is not a duke with an infinite clothing department at his command. Each person, however, who has two or three suits at his service would do well to adapt the use of them to the variations of the weather. Where it is common, as in the United States, to turn, by means of the ever-burning furnaces during winter, the house into an oven, it would be prudent to wear light clothes in-doors, and keep the thick ones exclusively for out-of-doors. At any rate, it would be well to wear much lighter clothing than usual within, and depend chiefly upon the cloaks and overcoats for comfort with-

out; and these should be adapted, so far as the extent of the wardrobe will permit, to the variations of daily temperature.

Young people, with an affected heroism, will often resist the putting-on of the overcoat, so earnestly urged by anxious parents. With the eager activity and rapid movement of most youth, they will sometimes be able to defy the severest cold with impunity; but they must not forget that there is nothing in their nature to free them from the penalties which follow disobedience to the laws of health. The rule for them, in the matter of the overcoat, is to put it on when they first go out of a warm room into the cold air of a severe winter's day. They may lay it aside on beginning active play, but they should resume it at once on ceasing. They are apt, however, to reverse this mode of proceeding, and keep the overcoat on at first, and take it off only at the last, when feeling the full effect of the heat of exercise. Nothing can be more dangerous, for at this time the evaporation from the excessive moisture of the skin will be very rapid, and quickly chill the body unless protected by thick and abundant covering.

The ordinary clothing worn in cold weather, though sufficient for comfort while a

brisk fire is kept up within the body by active exercise, is not so of itself during a long repose either in the open air or in-doors. It is, no doubt, possible to heap upon the person a quantity of bad conductors sufficient to retain in the coldest atmosphere the requisite animal heat, even while the body remains quite immovable. It would evidently, however, not be very convenient for any one, in the daytime at least, to be loaded with a mountain of fur, feathers, and broadcloth. With such a burden on his back, a person would feel very much as Sindbad the Sailor may be supposed to have felt with the Old Man of the Sea astride of his shoulders. During night, however, most people can, without inconvenience, bear almost any quantity of blankets, coverlets, and comforters, and by these means keep themselves, while lying down to sleep, comfortably warm in a room, however cold, or even in the open air in the frostiest weather.

As it is not convenient or even practicable to sit quiet or to go about our usual business within-doors while wearing the quantity of clothing necessary to retain in cold weather the due warmth of the body, we are obliged to resort to other means. We therefore heat our houses by the various familiar contriv-

ances of stoves, grates, and furnaces. These mainly act through the process of radiation. They, like all other bodies, are continually giving out and receiving heat in this way; and so long as their fires are kept up they will throw out more than they take, and thus fulfil the purpose of warming the interior and all persons and objects that are enclosed within it.

It must not be forgotten, however, that the use of these artificial means for producing heat is accompanied by dangers to health and life against which it is prudent to guard ourselves. An outlet should be provided for the poisonous products which are the result of fires of every kind. The air which they make impure must not only be got rid of, but the loss of that which they consume must be made up for by a fresh supply from the atmosphere.

Too much reliance, moreover, must not be put in stoves, furnaces, or other source of artificial heat. The habit of remaining in-doors during cold weather and "hugging the fire," as it is called, is a dangerous one. The heat obtained in this way only warms the surface of the body, and does not supply what is necessary not only for comfort, but health, and which can only be obtained

through active exercise and free breathing in the open air.

Questions.—What is the effect of the natural moisture of the body? How do wet articles of dress affect the body? How does clothing affect the natural radiation of the body? What is the rule for wearing the overcoat? How is warmth obtained from stoves and open fires? What are the dangers of stoves, fires, etc.? Is artificial heat a sufficient substitute for animal heat?

CHAPTER XII.

Hardening.—Foolish Dread of Cold Air.—Colds: how caught and avoided.—Imprudence of Boys and Girls.—Petting Colds.—Dr. Solander in the Arctic Region.—Chilblains and Frost-bites.

“He who does not dress warmly enough must be either a fool or a beggar” is a shrewd Scotch proverb. If a person has the means to clothe himself properly, and does not do so, he is supposed to be the former; and if he has not, he cannot, and therefore may be called, in one sense, the latter. Though it would be a harsh judgment to set down as a fool every one who fails to put on a sufficient quantity of clothing, such failure must at least be considered unwise. With a notion very common among youth of

hardening themselves, as they call it, they will often, by not taking the proper precautions to guard their bodies against the cold or inclement weather, incur the danger of loss of health. Children are very apt to laugh each other into such absurdities of conduct. With the false idea, started probably by some lad who has no warm coat to his back, and, like the fox without a tail, is anxious that all his fellows should be in the same predicament, that it is not heroic to enjoy the comforts of substantial clothing, whole schoolfals of boys will bare themselves to every wind that blows.

Some parents, too, seem to have the notion that their children can be hardened, or rendered insensible by exposure to the effects of temperature. They who hold this dangerous error will point triumphantly, in proof of their opinion, to those ragged yet sturdy offspring of poverty, who, in spite of their bareness, seem able to defy both the cold and the storm. These, however, are but the few of the many left untouched by disease. They are the hardy plants which have escaped the neglect and blight which have withered and killed most of those of kindred growth.

The surface of the body cannot, as is often

supposed, be hardened by continued exposure to cold or intemperate weather of any kind. The skin, when in a wholesome condition, is moist and soft, and, being constantly renewed, retains to a great extent its freshness and delicacy throughout life. Its tenderness and sensibility to changes of temperature and other impressions are thus preserved.

Many people have an unnecessary dread of the cold air, which seldom, if ever, unless its temperature is so excessive as to produce frost-bites and other worse effects, does any injury to a healthy person. It is common to attribute to it coughs, catarrhs, and other affections of the breathing apparatus; but these are not caused directly by its means. A sudden transition from a high to a low temperature, if the body should not be properly clothed, or otherwise protected, is certainly harmful; but this is owing to the change, and not to any unhealthy influence of cold. It is held, moreover, by some physicians of good authority, that even in such a case, unless there is more or less fatigue, the heated body can with safety be exposed to a considerable change of temperature without serious danger. When, however, there is exhaustion, as is apt to accompany

the heat which follows hard work or active exercise of any kind, it is not doubted that a sudden exposure to cold is full of risk to health.

The rule of safety is to guard against the changes of temperature which every one must be daily exposed to who puts his head or foot out-of-doors. This is readily done by having suitable clothing, and adapting its use properly to the occasion. Especial care, moreover, should be taken to protect the person with an abundance of warm covering at the very moment when there is a cessation of heating exercise of any kind. It is just then, however, unfortunately, that, with the feeling of excessive warmth, there is the least inclination to burden the body with heavy clothing. Foolish people, and careless children especially, are apt, in consequence, to do themselves a great deal of injury by consulting on such occasions their temporary comfort, and not the established rule of health. Boys, and girls too, will thus often, after active play, cast off a jacket, or some other easily shifted bit of clothing, and throw themselves, heated and exhausted, on the cold, moist ground. Nothing can be more dangerous. Instead of stripping at this time, they should put on

additional covering, and avoid, if possible, all such total quietude as lying down, especially on such a couch as is offered by the bare, damp earth.

With the notion, apparently, that there is something poisonous in the cold air, an immense deal of care is taken that not healthy only, but sick persons shall not be exposed to it. This is particularly so in regard to any one who may be affected with what is generally termed a "cold," the very name of which shows how close is the common association of its cause with a lowness of temperature. As to this disorder, in all its varieties, and every other, in fact, it may be truly said that the coldness of the air is a quality little, if at all, to be feared. The doctor, who, on first entering the bedchamber of a sick person, closed tightly against every breath of outward air, thrust his cane through the panes of the windows, much to the astonishment and horror of a stifling crowd of visitors, feared only the corruption of the atmosphere within, and boldly invited the pure atmosphere from without, with all its coldness. The quick recovery of the patient justified the doctor's audacity.

The usual "petting," as it is called, of a common cold, where there may be merely a

running from the nose or a slight cough, without any extraordinary heat of the skin, or any other mark of fever, is by no means the best manner of getting rid of it. It will be found that moderate exercise, in the open air, with a prudent adaptation of the clothing to the weather and season, is the best treatment. Monsieur Dupré, a great French singer, who had every motive for protecting himself against a cold, for each attack was a loss to him of thousands of dollars, declared, as the result of his experience, that it was better not to use too great or many precautions. It was well, he acknowledged, to avoid, as far as possible, exposure to sudden changes of temperature by care and proper clothing; but he avowed that the best protection of all was to fortify the body by exercise in the open air during all seasons and weather.

In parts of our country the cold, occasionally, is so severe as to produce serious and fatal consequences. Exercise and plenty of warm clothing, of loose texture and fit, are the best protection for those persons exposed to the dangers of severe frost. There is a tendency on the part of one who is subjected to, and begins to feel, the influence of a very low temperature to lie down and

sleep. Dr. Solander, who was the surgeon and naturalist of an early arctic expedition, reports that this somnolency was so irresistible in his case, that although he had impressed upon his companions the necessity of not giving way, or letting others give way, to it—for sleep, he knew, under such circumstances is certain death—he was the very first person to yield. Fortunately, his comrades had heeded his lesson, and as soon as the doctor fell back and threw himself upon the ice to repose, they aroused him, and continued to keep him awake, by all the means in their power, notwithstanding his most urgent solicitations to be left alone to sleep and to—die. They succeeded, in spite of his resistance, in disturbing his repeated slumbers, until he finally became wide awake to the imminent danger he had run, and lived to thank his companions for their faithful obedience to his instructions.

Frost-bites, of which the most familiar form is the common chilblain, are best avoided by brisk exercise in the open air, and keeping away habitually from hot stoves and fires, on entering the house, after exposure to severe cold. Rubbing the frost-bitten part with snow or washing it rapidly with ice-cold water is the best treatment at

first. Subsequently, if the skin should not be broken, friction with spirits, and an occasional bath of hot water with mustard, will be useful. Hartshorn and oil mixed, and the tincture of iodine, are good remedies; and when the skin is broken and an ulcer formed, the best application is what is known to the apothecary as zinc ointment.

Questions.—Can the surface of the body be hardened to cold? Is cold itself always harmful? How are colds, coughs, etc., produced? When is it particularly imprudent to throw off warm clothing? How should common colds be treated? What is the effect of severe cold upon the disposition to sleep? State the case of Dr. Solander. How should you treat chilblains and frost-bites?

CHAPTER XIII.

Summer Dress.—Cooling Processes.—Head-coverings.
—Franklin's Experiment.—Effect of Color.

IF we could regard merely our comfort, we should probably choose during summer—or, at any rate, in the hottest weather of it—to go naked, or wear the scantiest clout, like the savages of some tropical countries. The bare body would be most favorable to the natural processes by which it gets rid of its superfluous heat. These, as we know,

are evaporation, conduction, and radiation; which it is, of course, no less desirable to promote in hot than in cold weather, on the contrary, to check.

Civilized beings are forced to submit their bodies to clothing, inconvenient and uncomfortable as it may sometimes be, as it certainly is in excessively hot weather. Decency has its claims, that no modest person would wish, nor the most audacious dare, to resist; but there are certain demands of fashion it would be well that there might be a greater desire or boldness to oppose. People, if they were not governed absolutely by its capricious will, could, if controlled only by a sense of propriety, readily adapt their clothing to all the requirements of comfort and health. While, however, men will continue to wear stiff stove-pipe hats, black-cloth dress-coats and trousers, and pinching patent-leather boots, and women tight skirts of close silk, fastened to tighter waists, with superfluous hunches of stuff behind, and heavy hangings of every kind all around, in the dog-days, they must give up hope of either comfort or health.

Clothing of some kind being indispensable, even in the hottest weather, it should be so adapted, in material and make, as to

interfere as little as possible with the natural cooling processes of the body. To promote the evaporation of the moisture from its surface, which is one of the most effectual means of getting rid of superfluous heat, the covering should be as light as possible. All elaborate dressing, with multiplicity of fold and weight of trimming, must be avoided. Every thread and surface, of whatever kind of material, which interposes between the body and the air, will check to a certain extent the evaporation from the skin. The free action of the process of radiation, which is, as we know, another means by which the superfluous heat of the body escapes, will also be hindered in the same way. The less the clothing and the looser it is, the cooler will be the body, for it is proportionately able to get rid of its heat by evaporation and radiation. People with no pretensions to philosophy of any kind will instinctively, when free from the fear of fashion, act in accordance with its principles. The heated laborer strips off his coat, bares his sweaty throat, breast and arms, and loosens his girdle. He is thus refreshed by the cold which comes from the evaporation of the moisture of his body on its exposure to the surrounding air.

As in cold weather we cover our bodies with furs, thick woollens, and other bad conductors to keep in the heat, so in hot weather we should take care that the clothing which propriety compels us to wear shall be composed of the best conductors, in order to let out as much heat as possible. We therefore must dress in linen, cotton, and such-like material, which favor the natural conduction between bodies of different temperature brought into contact with each other.

Of course, in a climate like ours, where in the hottest seasons there are apt to be great and sudden changes from an extreme heat to a considerable cold, it is necessary to take precaution against their ill effect upon comfort and health. Thus, it is generally thought prudent to wear, even in summer, flannel next to the skin; for, though it has the disadvantage of being a very bad conductor, and keeps in the heat of the body, it has the advantage of being a good absorber of moisture, which, if not taken away from the surface of the person, might derange the health, as it always disturbs the comfort. During, however, the more settled season of midsummer in most parts of the United States, it may well be doubted whether the

constant discomfort of wearing the heating flannel is compensated by the occasional protection it may give against the rare chance of a chill. At any rate, it should be worn over the stomach, which requires to be guarded in hot weather more than the chest, which it usually covers. It is well to avoid the use of linen next to the skin; but cotton, which is the more common wear in the United States, is both comfortable and safe during our summers, with all their possible changes.

In a tropical country, and during the hot season of a temperate one like our own, it is not only necessary to adapt the clothing to the purpose of letting out the superfluous heat within the body, but keeping from it, as far as possible, that which besets it from everywhere without. To protect the person from the direct rays of the sun, umbrellas and parasols are carried, and wide-brim hats worn. The Anglo-Indian, as he is called, or the Englishman who has lived in India, or who affects to have done so, may be occasionally seen, even in our streets, wearing a covering which has been adopted from a practice in the East Indies, that gives him the look of an Irishman who has had his head cracked in a row or a shindy. It is a

white clout, or striped shawl of some kind, wrapped in folds about a low felt wide-awake or other head-piece, which is worn as a supposed guard against sunstroke. Its efficacy for that purpose may be reasonably doubted, while it is unquestionable that with its weight and heating effect such a covering is favorable to neuralgia and headache.

There is a familiar experiment, first made by our countryman, Benjamin Franklin, which proves that the color of all materials has a great effect upon their power of absorbing heat. He took a number of pieces of cloth of the same size and kind, but of different color, and placed them on a bank of snow, exposed directly to the sunshine. He soon found that the snow melted more rapidly under some than others, and discovered that this was in proportion to the darkness of their tint. The snow under the black cloth was the first, and that under the white the last, to melt. He accordingly drew the inference that the absorbing power of heat of dark substances was greater than that of the lighter color. The result of this experiment has been acknowledged as establishing a scientific principle which practical people have confirmed by the experi-

ence of habitual usage. White garments have been found to be much cooler than dark ones of the same material. When a boy, therefore, throws off his jacket, which is ordinarily of some deep color, and exposes his shirt-sleeves, in hot weather, he cools himself by two processes. He not only lets out internal heat, by getting rid of a bad conductor, but keeps off external heat by substituting a bad absorber for a good one.

A white or light-colored straw hat will, of course, be cooler to the head than a black or dark-colored one. As the hair, if it is possessed in ordinary abundance, will generally be a sufficient covering in all seasons, it may be doubted whether a black hat, of any material, is ever necessary. If fashion were less peremptory, and people were allowed to regard their sense of comfort more, the white hat would be oftener seen even in winter.

Questions.—How is the body cooled in hot weather? What should be the object of summer clothing? Are good or bad conductors the best for cooling the body in hot weather? Why is flannel worn even in hot weather? Explain Franklin's experiment. How does color affect the warmth of dress?

CHAPTER XIV.

A Philosopher in an Oven.—The Transpiration.—How a Hot Climate is endured.—Whites and Blacks.—Innocence of the Sun.—Sunstroke.—Its Treatment.—Light.—Effect upon Health and Life.

A FAMOUS English philosopher tells us that he went into an oven hot enough to broil a beefsteak, and remained there until one was thoroughly cooked. He, moreover, states that during the whole time he bore the heat without much discomfort and with no serious consequence. He took care, however, to protect his hands and feet with several layers of felt, or some other bad conductor, lest the contact with the pavement or the walls of the heated oven should broil his flesh, as well as that of the cooking steak. While making this experiment of his power of enduring heat, the philosopher, as may be readily conceived, was constantly in a state of profuse perspiration. It was by this means alone, in fact, that he was preserved from a broiling as thorough as that of the dead piece of meat at his side.

There is a transpiration, or sweating proc-

ess, going on always from the surface of the living body. This is greatly affected by the surrounding temperature, and it is thus chiefly that the body is adapted to the endurance of extreme changes. When the heat is great, there is an abundant transpiration, the moisture of which, on evaporating, produces cold, and thus checks the increase of warmth, come from whatever source it may. As the English philosopher was enabled, by the profuse perspiration from his body, to endure a heat great enough to broil a steak, so people living in hot countries, by the same means, are able to live in good health and tolerable comfort during the hottest weather.

Those persons who have passed the greater part of their lives in a cold climate are thus enabled to bear the most sudden change to a hot one. It must be acknowledged, however, that, with the advantage they possess of the transpiring process common to all, they are less able to endure the excessive heat of a tropical country than those of its native race. These are generally negroes, or dark-colored people of some kind, who are provided with a charcoal-like substance under the skin—from which its tint comes—that seems to protect their bodies from the

ill effects of the prevailing heat. In Africa, the East Indies, and other hot climates, the white people of European descent, although able by natural endowment and prudent precaution to enjoy comfort and health in a more or less passive state of repose, cannot easily or safely vie with the dark native races in bodily activity while exposed to a tropical sun. The difference, however, in the natural powers of endurance, under the like circumstances, is not so great as is generally supposed; and if the white man of Europe were content to live, as necessity compels the black man of Africa, their capacity to bear heat would probably be less unequal.

People are apt to be unnecessarily timid of exposure to the rays of the sun. They seem to fear them, as some old-fashioned folk do the light of the moon, as if they attributed to solar as to lunar radiation an influence fatal to mortal wits. It is now acknowledged by sensible persons that there is no danger to be feared from the moon, and it may be doubted whether the sun is a much more reasonable cause of alarm.

There is a serious affection called sun-stroke, which is generally supposed to be a direct effect of the solar rays, but is oftener

due to the exhaustion from hard work or severe exercise while exposed to them. The heat alone, except, perhaps, in the case of a few very susceptible persons, would hardly cause sunstroke, which is seldom observed to occur without some imprudent bodily exertion during excessively hot weather. While people may generally without harm, and even with benefit, bask in the summer sun, it is not safe for them to move actively, as in severe work or exercise, if its rays are striking directly upon their heads.

Children, in the rivalry and excitement of play, are very apt to over-exert themselves at all times. They generally, thanks to the freshness and elasticity of youthful vigor, recover from the immediate effects of fatigue and exhaustion. They should, however, be put on their guard against the risks of over-exertion during excessively hot weather. Shady places should be sought on every occasion of active out-door amusement during the hottest part of the day, and all temptations to long runs and great efforts of strength in the broiling sun be avoided.

In any case of sunstroke, or great exhaustion from exercise while exposed to the heat, the first thing to be done is to remove

the sufferer from the causes which are supposed to have produced it. His own weakness and prostration will necessarily disincline, if not entirely hinder him, from making any further bodily effort. He should be carried to the nearest shade, or, at any rate, protected from the sun's direct rays, wherever he may be, and made to lie down at full length, and cold water applied at once to his head and lips. His lower limbs should be kept warm, with such covering as there may be at hand, and his neck and body freed from any close-fitting garments or binding article of dress. Most will revive readily under this simple treatment, and suffer no further ill consequences, but they must be carefully prevented from making the least effort immediately after apparent recovery. They should be carried, and never allowed, if possible, to walk home; and, when there, kept quiet and within-doors, for some hours at least, or longer if there remains any sign of exhaustion or discomfort.

If the heat of the sun may sometimes do mischief, its light never does. It, next to the air, is the requirement most necessary for health and life. Without light, most animals, and even plants, dwindle, become dis-

eased, and die. The gardener who cultivates celery for the table is careful to heap the earth about it so as to exclude the sun's light, in order to give it the whiteness and tenderness which are required to please our artificial taste. Whiteness and tenderness, however necessary to our enjoyment at table of the celery, are only signs of the weakness of the plant, in consequence of being deprived of its due supply of the sun's light. Greenness and toughness are its healthy qualities, but we prefer its diseased ones, whiteness and tenderness, and therefore the gardener takes care to produce them for us.

The same effect follows the same cause in human beings. When deprived of the sun's light, they become white and tender, or pale and weak. This can hardly be regarded a desirable result for creatures to whom strength and health are necessary for the work that it is evidently designed for all to do in this world. Foolish women, however, who seem to think that they are only created to be looked at, and, with the false idea that tenderness and paleness are essential to beauty and attractiveness, are as careful as the gardener with his celery to shut out the light of the sun, lest they should have too much color and vigor to

please the fashionable taste. They pull down the blinds at home, and spread their parasols whenever they go out, and thus take care not to let a glimmer of sun on any occasion brighten or invigorate them.

There are some poor wretches whom necessity compels to live in darkness, and the effect is seen in their pale complexions and diseased bodies. Miners who spend their few days beneath the surface of the earth, and the many miserable inhabitants of large cities who are compelled to make their abodes in cellars and other holes burrowed into it, soon become sick, and quickly find a grave underground, where they had sought a home.

Not only is the sun's light a good preserver of health and vigor, which every healthy person, young or old, should freely avail himself of, but it is one of the most useful remedies for weakness and disease. It is the practice, and a very good one, in the Child's Hospital of Paris, to arrange the little patients in successive rows upon a broad wooden structure, and expose them on every clear, warm day directly to the rays of the sun; taking care, of course, as should always be done, to protect the eyes from the glare. Nothing is found to offer

these weaklings such a chance of becoming strong enough to keep and enjoy life. "Second only to their need of fresh air is their need of light," says Miss Nightingale, in the account of her great experience with the sick. "After a close room, that which hurts them most is a dark room, and it is not only light, but direct sunlight, they want."

Questions.—State the oven experiment of the English philosopher. How was the excessive heat borne? By what means are people able to bear the change from a cold to a hot climate? Why are dark-colored people better able to bear heat than light-colored? What is sunstroke? What is the proper treatment of sunstroke? What is the effect of light? Give an illustration of the effect upon vegetables of the deprivation of light. How are human beings affected by the deprivation of the sun's light? Is the sun's light good for the sick?

CHAPTER XV.

Rarity of Good Water.—Pure Water of Nature.—How polluted by Man.

THERE is nothing so hard to find nowadays as a glass of good water. It is no fault of Nature, for she supplies this essential element of life in great abundance and purity.

Her grand process of distillation is ever going on, by which she raises from exhaustless oceans clouds of vapor, and pours down from them showers of rain and storms of snow upon the vast surface of the earth, and thus fills and refills the bubbling springs, the countless trickling rivulets, the mountain torrents, the meandering streams, and great rivers, which, after the beneficent purpose of this glorious gift of water to the world has been effected, return it to the source whence it came. Here, in the grand laboratory of nature, it is again made fit, and sent to renew, in vapor, cloud, spring, and stream, its generous service; and thus it goes throughout all time, from ocean to river, and river to ocean.

Water is not only naturally supplied in exceeding abundance, but in great purity, for the use of man. The rain, if collected anywhere away from the touch of human pollution, will be found to be almost chemically pure, or to contain little else than the parts of which, according to the chemist, water is essentially composed. These have been proved by chemical experiment to be the two gases oxygen and hydrogen. The processes used for the purpose are ordinarily called "analysis" and "synthesis," two

words derived from the Greek, and which may freely be interpreted, the former as a *taking-apart*, and the latter as a *putting-together*. The same power is applied in setting to work each process; this is electricity. Obtaining a small supply of water made as pure as possible by means of careful distillation, an electrical spark is passed through it, and being thus analyzed, or separated into parts, the two gases hydrogen and oxygen are only left. Again, these two gases being brought into contact, and made to undergo the process of synthesis, or putting-together, by also passing an electrical spark through them, the result is the formation of water.

The scientific water, as it may be termed, is, however, only to be found in the laboratory of the chemist. That which nature supplies, though it may well deserve to be called pure, since it is wholesome for the purposes of man, contains something more than the two gases oxygen and hydrogen. Even the rain-drop, which approaches most closely to the water of science, is always impregnated with the various matter met with in the air during its fall from the cloud to the surface of the earth. In fact, scientifically pure water would not be palatable,

and probably not healthy to drink. Rain-water, even, though it is generally regarded as very wholesome, has a flat, disagreeable taste to those unaccustomed to drink it. Carbonic acid gas in certain proportions, and other constituents ordinarily found in unpolluted springs and fresh streams, seem essential to the flavor of drinkable water.

Notwithstanding the abundance of the natural supply, it is a very difficult matter, indeed, to obtain the smallest quantity of wholesome water. All its sources, showers, springs, rivulets, and rivers, wherever they fall, rise, and run within the easy reach of man, are very apt to be polluted by his touch. Their abuse is no less universal than their use. It is sad, moreover, to know that it is the human being in his civilized state, and not in his savage condition, who is the worst offender. It is he who is led, by his social culture and refined taste, to live with his fellows in towns and cities, which by their united skill they raise for the convenience and enjoyment of life; it is he whose ingenuity has applied the power of steam to his uses, and built workshops and factories to administer, by their countless contrivances of art, to the wants of civ-

ilized man ; it is he whom Christian charity has taught to establish schools and libraries, and found asylums and hospitals ; it is he who is the offender.

Civilization has certainly its bright side, in the reflected glory of which every cultivated person has reason to glow with pride. Civilization, however, has its dark and dirty side too, in the dingy shadow of which all civilized men should hide their heads in shame. There is nothing so disreputable to so-called modern progress as the complacency with which it continues to flounder in its own filth. There is a certain foulness inseparable from almost every act of the civilized being, however refined. The artist cannot give reality to his conception of grace and beauty without dribbling paint, or raising a dust, or making a stain or a litter. All the great works devoted to the supply of material for the use and enjoyment of civilized beings, whatever may be its nature, are producers of filth. This, moreover, is often the greater as the manufactured product is the more delicate. The soap and perfume which scent the hands and the handkerchief of the exquisite are of so foul an origin that neither the sources from which they come, the processes by which they are made,

nor the waste substances they leave, are endurable within smelling distance, and are universally pronounced nuisances.

It is this foul waste matter of various contrivances of civilization for adding to the beauty and happiness of life which so greatly pollutes the sources of the water which is supplied by nature in such abundant purity. The smoke, vapors, and dust rising from every inhabited town or city turn each drop of rain, pure as it may have fallen from the heavens, into a drop of poison before it reaches the earth. The sweepings and refuse of the houses, shops, and streets, and the offal of the shambles, and the waste products of manufactories of all kinds, borne away sooner or later into the streams and rivers, contaminate them. Mankind have been so eager to satisfy the demands for work, that they have not taken time to clear away the litter. Thinking only of the immediate profit, from the urgently required and quickly despatched article, they have failed to calculate the future loss to health and happiness from the permanent nuisance. Thus their abounding waste is left to accumulate, or flung carelessly aside, to be washed away and mix with and poison the water-sources, which become

in this way one of the principal means of producing and disseminating disease.

Questions.—Explain the circulation in nature of water. What is the purest natural water? What is the composition of water? State the experiments by which the composition of water was discovered. Is natural water chemically pure? What are the sources of the pollution of water?

CHAPTER XVI.

Poisoned Water.—Diffusion of Cholera and Typhoid Fever.—Germs.—Death and the Dairy-man.

WITH the dirty habit that so-called civilized people have of casting all their filth into the nearest stream or river, and crowding pigsties, cow and stable yards, necessaries, dunghills, dust-heaps, cesspools, and the various receptacles of dirt close to springs, wells, and other sources of the water used, it is not surprising that we take in with our daily drink a good deal besides the oxygen and other constituents of which it, in its natural and wholesome state, is composed. The water we drink is not only thus made dirty and impure, and therefore generally unwholesome, but is often turned

into a specific poison, so virulent as to cause some of the deadliest diseases that infect the human race.

When the cholera, typhus, and typhoid diseases, the small-pox, scarlet-fever, or some other pestilence, attacks whole communities, it is common for some people, more or less barbarous, in their ignorant fright to cry out that the springs and wells and other sources of their drinking-water have been poisoned by their rulers, against whom they will often rise, and wreak upon them the utmost violence of a furious mob. Wrong-headed as an excited populace are apt to be, their judgment is so far rational in this particular that it concurs with the calm opinion of men of science, that the poisoning of the sources of water in daily use is one of the most frequent causes of pestilence. The populace certainly, in their blind rage, unjustly accuse their rulers of a deliberate crime of which it is hardly possible, with all the enormity of tyranny and cruelty, to conceive them capable. They, no doubt, have their responsibility, in common with others; but it is the people themselves, chiefly, who cast the poison into the fatal draught the mixing of which they attribute to other hands.

Persons suffering from certain ailments are supposed to be casting off germs, or seed, of the disease they may have during various stages of its progress. These germs pass off, it is conjectured, sometimes from the lungs and surface of the body, being breathed or sweated out, and, entering the atmosphere, are thus conveyed to healthy persons, who take them in with the air they inhale, or absorb them through the skin, and thus become, in their turn, afflicted. In certain diseases, as the typhoid fever and cholera, for example, the more common mode of the passage of the germs would seem to be through the bowels of the diseased person, and these are the germs which by the filthy practices of mankind are chiefly allowed to get into the water of common use. Hence our daily drink often becomes a poison so fatal, and the frequent cause of the most mortal diseases with which the human kind are afflicted.

Cholera, whatever may be its origin, is undoubtedly propagated by foul water. The course of the mains, or chief water-pipes, in London was found to indicate exactly the progress of this fatal disease during several epidemics. Those districts where the water thus supplied was foul

were struck with cholera, while those furnished with pure water escaped unharmed. Even where two mains ran side by side, in one of which was polluted and in the other unpolluted water, the disease was confined exclusively to the people who obtained their supplies from the former. In Guilford, a small town in England, two hundred and fifty cases of typhoid fever occurred within the short space of a single month. The district in which they happened was found to be supplied with water from "a reservoir filled from a new well, which, through the drainage of a fissured chalk stratum, received the soakage of several sewers."

Not long since, there broke out in one of the most fashionable quarters of London a frightful epidemic of typhoid fever. As case after case occurred, rapidly following one another, it was noticed that the disease was confined to certain houses within a fixed boundary. Here it struck down the inmates of a dwelling on one side of a street, there on the other; now it attacked the inhabitants of an entire row, and again, passing by a whole block unharmed, turned the corner and renewed its ravages in the same apparently eccentric manner, running, as before, along a line in one direction, and

then crossing and recrossing, and leaping from house to house. Among the victims of the disease were some members of the family of a shrewd physician, whose scientific zeal, being stimulated by his self-interest, led him to investigate the matter. Noting the fact that the disease had shown a partiality for certain houses within a particular district, he very naturally sought out what they might have in common to give them this fatal preference. He found that they were all supplied by the same dairy-man, and that his daily course in distributing milk corresponded exactly, house to house, row to row, and street to street, with the march of the typhoid fever. With this significant fact to guide him, the physician was easily enabled to trace his farther way. Once on the route of the dairy-man, he tracked him to his dairy, and there immediately reached the source of the whole deadly mischief. It was ascertained that a laborer had died of typhoid fever on the farm whence the milk was obtained, and the common receptacle of all filth, that of the diseased man included of course, was found to be so close to the source of the water in daily use that the contents of the two could not fail to intermix with each other.

It did not appear that the fatal milk had been "watered" by this horrible mixture, but it was acknowledged that the cans had been daily washed, if such a term can be used, with it. Thus the germs which had passed from a single laborer, dying of typhoid fever, in the country cottage of a dairy-man, had been conveyed to the great metropolis, and poisoned a large number of the inhabitants of one of its most opulent and apparently best-protected districts.

"Another death, making the twelfth, is reported as the result of the epidemic at Eagley, near Bolton," is the announcement of the *Daily News* of London, at the moment of this writing (March 2d, 1876), of the continued havoc making by the typhoid fever in a small English hamlet. Though a full investigation has not yet been made into the circumstances of this fatal epidemic, it is confidently stated that the use by a dairy-man of a stream polluted by the poisonous germs of typhoid fever is the cause of its occurrence. "The Mayor of Bolton has been urged," consolingly remarks the newspaper editor, "to adopt measures to prevent offensive matter flowing into the Heaton Reservoir, which is one of the sources of the water-supply." It might be thought that

the urgency to act was apparent enough when death was seizing its victim as the penalty for each moment's delay, and that it was time for mayors, and all other persons in or out of authority, to be up and doing.

Questions.—How does water become the cause of disease? Mention some of the diseases known to be produced by means of water. State some facts to prove that water is the cause of disease.

CHAPTER XVII.

The Necessity of Water.—Prejudice against Water as a Drink.—Dangerous Substitutes.—Deceptive Look and Taste of Water.—Precautions to be taken in drinking Water.—Suitable Beverage for the Young.

THE difficulty of getting a glass of wholesome water will now be understood. This, notwithstanding, must be had, for there is nothing which nature or art produces that can take the place of pure water, which is essential to satisfy the wants of man. Its rarity, however, has led people to resort to all kinds of attempts to find substitutes, which, though they may temporarily refresh, do finally much more harm than good. Beer, wine, spirits, and the various other kinds of fermented liquor so universally

drunk, find the best apology for their use in the difficulty of getting pure water. If this were more easily attainable, there can be little doubt that other beverages would be less readily taken, and their abuse greatly prevented. The pollution of springs, wells, and streams becomes thus a source of moral as well as physical corruption, and that most degrading vice, drunkenness, is greatly due to the scarcity of pure water.

There is in many countries such a prejudice against water as a drink, that it seems almost to have gone out of use for that purpose. There is nothing which so much astonishes a native of Germany and France as the call by an American traveller for a glass of water. When the call, moreover, is made, there is nothing so difficult to obtain as a satisfactory answer to it. "*De l'eau, monsieur! Monsieur demande de l'eau!! Mon Dieu!!!*" "*Wasser! Ach!! Mein Gott!!!*" If the American persists, as he generally does, in getting what he calls for, he may, after a prolonged trial of patience, be served with a scant supply of the simple fluid he wants; but a drop no sooner touches his lips than there are observed a contemptuous shrug moving the shoulders of every watching *garçon* and *Kellner*, and a look of each French-

man and German of the company fixed in mute horror at the daring and unexampled venture of the foreigner to drink—a glass of water! This difficulty of supplying the means of satisfying one's thirst in a natural and inexpensive manner might be supposed to be affected by waiters at hotels for the purpose of forcing, for their master's benefit, a more frequent recourse to the obvious and costly wine-card, if it were not so universal on the continent of Europe. The glass of water is as inaccessible in the private as in the public house. There no native drinks water, if he can help it, or takes it when unavoidable without an evident protest, by look or word, against its use. This common aversion to water as a beverage, and the general opinion that it is unwholesome, come probably from the fact that it has been found by experience to be a frequent cause of disease. That it should be so is not surprising, for throughout the continent of Europe there is an almost universal ignorance and disregard of the laws of health. There is no effectual drainage, and consequently where the pure and impure are allowed to mix, without distinction, there can be no other result than a common foulness. The well and public fountain are close to

the street gutter, the factory-pipe, and cess-pool; and the water drawn and poured out from the one is tainted by the filth dripping from the other.

The danger of being poisoned is all the greater from the fact that it is generally impossible to distinguish the pure from the infected water. It may look as clear as crystal and have the most agreeable taste, and yet contain an element fatal to health and life. A fountain may pour forth a limpid stream tempting to the sight from its diamond-like glitter, pleasing to the palate and refreshing to the thirst from its deliciousness of flavor, while every drop of its water is impregnated with the very essence of disease. The germs of typhoid fever, for example, cast with the scourings of some poor sufferer or other into the cesspool or any other general receptacle of the foulness of the household, will pass through the ground for a considerable distance with such fluid as they may be floating in to the nearest well, spring, or river, and poison all its water, though neither the ordinary observer nor the scientific chemist may be able to detect them, while the effects in the dissemination of the disease of which they are the seeds are obvious enough.

Until people cease the malignant carelessness or stupidity by which they are led to mix the poison they distil with the drink they offer to thirsty human beings, it will be necessary to investigate with a great deal of care the source of every drop of water before it is allowed to pass the lips. It might be supposed that in the country, where it is customary to seek refuge from the dangers to health and life of the populous town, one would be safe from being poisoned, at least by water. The pure spring and clear stream are regarded as such essential features of the rural retreat that it is natural enough to believe in their existence. Pure drinking-water, however, is more likely to be found, with all its inevitable sources of pollution, in the great city, than in the most retired and least-frequented village. The intelligent enterprise of the metropolis seeks, even in its most distant sources, for pure water, and brings it daily to each mouth from rivers and lakes leagues away; while the doltish indolence of the hamlet is so loath to move that not a step is taken beyond the reeking cow-yard to secure this essential of life, which nature supplies in such abundance, and generally so near at hand.

Young folk are the most incautious of all

drinkers, and there is no doubt that on this account they are so frequently affected by the various diseases which are known to be conveyed by water. Children, in the heat of play, are ready to quench their thirst at any source the most convenient. They make no inquiry and heed no warning, but will scoop up handfuls of water out of the first running creek, or open their mouths at the spout of every corner pump. There is, however, great need of caution, and they are earnestly entreated to keep alive to the danger of drinking water at every source. With a little observation and caution, they can readily avoid a good deal of risk. When they see a well, pump, or spring very near to a dwelling of any kind, whether for man or beast, let them avoid drinking from it, and never touch a drop of water, however inviting it may look, which has been drawn from any source close to a dunghill, a stable, or cow-yard, a dust-heap, a cesspool, or any place where the filth of the household is thrown, or to which it can find its way.

Water, if pure, may be drunk at any time and in the greatest abundance, but there is a method which must be strictly followed in swallowing it. It should never be gulped down, as it is apt to be, by children who

will drink a full tumbler without drawing breath. The first mouthful should be completely swallowed before a second draught is taken; and if the drinker is heated, the water should be only sipped, with frequent pauses after every sip or two. With these precautions, the coldest, even iced, water, and in abundance, can be drunk with perfect safety under any circumstances, whether of health or sickness.

There is no beverage which can be safely substituted for water, for the use of youth, at least. They had undoubtedly better not take even tea or coffee, however diluted. Wine and spirits should never be touched by children, not so much on account of their immediate effects, which are not without risk, but for fear of creating by habit the unnatural taste, for such it is, for strong drink, the fatal consequences of which to decency and virtue of life even the youngest must be aware of.

Questions.—How does the scarcity of pure water affect the morals of people? Account for the prejudice on the continent of Europe against the use of water as a drink. Is it easy to distinguish pure water? What precautions should be taken in drinking water? What is the proper mode of drinking water? What are the dangers of the usual substitutes for drinking-water?

CHAPTER XVIII.

Digestion.—Mastication.—Teeth.—Use and Abuse.

As most food, before it is fit to be eaten, has to undergo certain processes of preparation, so when taken into the body it can only be adapted to the purposes of life after being subjected to various operations. These are described under the general term of "digestion," a complicated function composed of many parts, which, being somewhat similar, may be compared to the familiar process of cooking.

The cutting or chopping of the various articles of food by the cook to make them yield more readily to the boiling, roasting, stewing, frying, and other kitchen doings, is like the first process essential to animal digestion. This is called "mastication," from the barbarous Latin term *masticatio*, which can be translated into the English word "chewing." The instruments for the purpose with which the human body is supplied are termed "masticators," but are much better known under their familiar name of teeth.

Mastication is a very important yet simple process; but, notwithstanding its importance and simplicity, it is apt to be ill performed, or not at all. Children are generally very negligent of this necessary work. Possessed naturally of the best possible tools in their regular sets of firm teeth, they use only to abuse them. They are applied to every imaginable purpose but the right one, the masticating of food. A child will delight in splintering a pignut, impenetrable to the sharpest-toothed squirrel, and making a mash of a musket-ball capable of piercing an iron-clad, but will scorn to use a tooth in crushing a morsel of bread or dividing a bit of tender meat. Of the effect of this abuse of his teeth, there will be soon occasion to say something. Against the dangers of the neglect of their use in masticating his food he is now warned. The food of most animals requires to be well broken up, and softened almost into a paste, before it can be properly acted upon by the various other processes essential to good digestion, and consequently to vigor of health and life.

The bird which apparently gulps down its food whole without first chewing it, has an apparatus which serves the purpose of the

set of teeth it has not been provided with. In its gizzard it has a very powerful masticator. This is composed of an exceedingly thick and strong hollow muscle, which contracts upon the food, all of which has to pass through it before being finally swallowed into the stomach. The bird, moreover, led by instinct, or by whatever impulse or motive it may be called, picks up a plentiful supply of gravel, which, entering the gizzard, greatly assists the grinding power of that masticating organ. Every one who has any experience of keeping tame birds is well aware of the necessity of spreading earth or sand on the bottoms of their cages, that they may have the chance of furnishing themselves with the pebbles or gritty particles essential to the due breaking-up of their food. If not thus provided, the imprisoned bird will immediately show signs of suffering, and, after pining away for some time, probably soon die.

Children, now that they know how important a process the cutting and grinding up of the food is to health and life, will perceive the great danger of not using their teeth in thoroughly masticating their food. It does not matter how easy to swallow the morsel may be, it requires to be well chewed

and turned about in the mouth, and should never be bolted whole. Children must remember that they are not boa-constrictors (which are, by nature, gulpers, or bolters), but animals provided with teeth expressly for the purpose of chewing.

Youths, with their fresh powers of endurance, may seem to be able to withstand the effects of a good deal of irregularity; but though they do not suffer from them immediately, they will be sure to do so sooner or later. Hasty eating is not only an offense against decorum, but is often the cause of the disease termed "dyspepsia," and of various serious derangements of the stomach and other organs of digestion, so common in this country as to be regarded as peculiarly American. When the habit of devouring the food so rapidly as not to admit of its due mastication has been established, as it generally is, in childhood, it is extremely difficult to abandon it in more advanced life.

The teeth, which are intended for a certain indispensable service, must not only be made to do it, but kept in a proper condition for the purpose. They are certainly tools composed of materials well tempered and of great durability; but their work is hard and constant, and they must be well

cared for, and properly, or they will fail to perform the life-long duty required of them.

It is common to treat the first set of teeth—which begin to show themselves in infancy, and continue to come in succession until they reach, at the early age of eight or nine, from twenty to twenty-four in number—as of very little importance, and hardly worth any care, since they last only to the eleventh year. This, however, is a grave error, for the beauty and strength of the second set, or the thirty-two *permanent* teeth, as they are termed, will depend a good deal upon the treatment of the first, or twenty-four *deciduous*, or shedding, ones. They are closely related, for hardly is one of the latter fully developed when another of the former begins to grow beneath it, and what is harmful to either will be apt to be so to both. The first teeth should be kept clean by daily washing of the mouth in the earliest periods of childhood, and in the more advanced by the use of a very soft brush. The attempt to crack nuts and gnaw ivory buttons, or to do anything, in fact, by which the teeth are jarred severely, or may be chipped, will not only injure them, but seriously damage the prospects of their successors.

The common impatience to get rid of the first set of teeth leads to the working at them when they may be a little loose. It is a bad practice. They should be left undisturbed until they are ready to be cast on the absorption of their slight roots, a process which is not complete until the new and permanent teeth are ready to make their appearance above the gum. They may then, at the last moment, when their hold is of the slightest, be aided by the gentle effort which will only be required to detach them.

The *permanent* teeth, that they may be worthy of their name, must be treated with the utmost care. They should be cleaned at least twice a day—on rising from and going to bed—and it would be well, also, to rinse out the mouth after each meal. A soft brush only should be used, and nothing but pure water will be necessary besides, if the cleansing of the teeth is habitual and frequent. When from neglect they have been allowed to become dirty, a little of the finest soap may be employed. All fancy powders and washes should be avoided, for, however good their immediate effect may seem, their habitual use will probably destroy the enamel of the teeth. This enamel, which covers the upper part or crown of the tooth, as

it is called, is certainly a very hard substance, but even it will yield to constant friction of hard or application of acid substances. It also is apt to be chipped off by being brought suddenly and violently into contact with any hard material, whether it be hickory-nuts or musket-balls; and if it should be chipped off or otherwise destroyed, the decay of the tooth will be sure to follow.

The shock, moreover, which the tooth receives from cracking nuts, or attempting to crush any excessively hard substance, will loosen it from its socket in the gum, which will become, in consequence, detached from its connection with the crown of the tooth, which is there protected by its coat of enamel, and, shrinking, expose the root of the tooth, which, being unguarded, will soon yield to decay.

Questions.—What is mastication? How do birds masticate their food? Why is mastication necessary? How many teeth compose the first set? How many are the permanent teeth? How are the first teeth to be treated? How are the permanent teeth to be treated?

CHAPTER XIX.

Saliva.—Use and Abuse of Taste.—Swallowing.—Its Dangers. — Mr. Brunel's Escape. — Remedies for Choking.

IT is not enough for the food to be cut up, which is done by the front teeth, called the *incisors*, or cutters, and ground by the back ones, termed *molars*, or grinders. It has to be moistened, particularly if the morsel eaten be very dry, for otherwise it could not, however finely cut or ground, be readily swallowed. While the masticating or chewing, then, is going on, if this important operation be properly performed, the food becomes mixed with the *saliva*, or spittle, supplied by little glands inside of the mouth. This is a fluid principally composed of water, but it has also a small quantity of albumen, which is the same substance as the white of egg, and some soda. These have not only the effect of smoothing and making the chewed and moistened food slippery, that it may be more easily swallowed, but also dissolve it to some extent, and thus assist in preparing it for the uses of the body.

The saliva is therefore of great service, and should neither be wasted nor abused. The habit of throwing it from the mouth on every occasion, or polluting it with tobacco-juice or anything else, is not only nasty, but harmful.

It is during the chewing of the food that the pleasure of eating is chiefly felt. By this active process the morsel is turned round and round in the mouth, and, being thus brought into close contact with the tongue and the palate, where there are nerves especially provided, is fully tasted and its flavor extracted. We are not, however, endowed with this taste merely for the gratification of sense, but it is given to us both as a motive to take food, and as a means of judging of the proper kind. The tongue and palate, therefore, not only administer to our pleasure, but watch over our safety. They are ordinarily faithful servants and protectors, if not spoiled by over-indulgence, or rendered indifferent to their duty by brutal treatment. The taste is easily corrupted, and young people are accordingly warned against every abuse of their tongues and palates. They must check their excessive fondness for sucking sweets, their great proneness to imitate old-

er fools in chewing and smoking tobacco, and their own frequent practice of exercising their jaws and powers of suction upon the tough india-rubber, the flinty rattan, and other substitutes for the sickening quid and cigar.

The morsel of food being well chewed, softened, smoothed, and tasted, is now, if acceptable, swallowed at the will of the eater. The process of swallowing is performed apparently so easily and ordinarily so carelessly that it is usually regarded as an operation entirely free from danger. There is, however, at the very beginning a certain risk, of which it is well to be aware.

There are two long passages which lead from the mouth into the interior of the body. These are the windpipe and the gullet. Through the former the air passes in and out of the lungs, and through the latter the food enters the stomach. They both open at the back part of the mouth close to each other, the windpipe just in front of the gullet. There is a lid attached to the entrance of the former, over which all food must pass to get into the latter. This lid is ordinarily closed during the act of swallowing, and the food passes readily over its smooth surface into the opening of its proper passage, the

gullet. Sometimes, however, this lid is suddenly opened just as the morsel to be swallowed reaches it, and then the food gets into the opening of the windpipe—*going the wrong way*, as it is familiarly called—when that sputtering and coughing ordinarily occur which so frequently happen, especially to young people, when eating. The sputter and cough are the means by which the windpipe tries to get rid of the intruding food; and, fortunately, these generally succeed, or very great mischief might occur. Children are often told not to speak while they are eating, and they would do well to obey the command, not only for politeness, but for health and life's sake. The reason that it is dangerous to talk while eating, is that, for the purpose of speech, the lid is opened which covers the entrance of the windpipe, in order that there may be a free passage for the air, which is essential to voice; and this occurring at the same moment the food is attempted to be swallowed, some particles of it are sure to get into the wrong passage. Laughing or crying, in fact, will have the same effect, so that if they are to be done, some other time than that set apart for eating must be chosen. The familiar sputter and cough, unfortunately, do not al-

ways succeed in turning out the intruding particle of food from the windpipe, where it has no business to be, and does so much mischief as long as it remains. When the substance is hard or heavy, it is apt to get too far in, and to stick there too fast to be easily expelled by any natural effort. The surgeon then must be called in; and if he has not the skill or the instruments to extract it, very serious consequences may ensue.

An accident which befell Mr. Brunel, the famous English engineer, who designed the gigantic *Great Eastern* steamer, and completed the construction of the Thames Tunnel, devised and begun by his father, will show the danger there is of whatever may be in the mouth falling into the windpipe. The simple means, moreover, by which Mr. Brunel was enabled at last, when almost all hope was gone, of escaping from the imminent risk to his life, proves how sometimes a little common-sense will do what a great deal of science fails to effect. Mr. Brunel was pretending, greatly to the delight of a group of little children, to swallow a sovereign, the English gold coin so called. He had put it into his mouth for the purpose of his playful deceit, when he was suddenly

tickled to laughter by the startled surprise of the credulous youngsters about him, and the piece slipped into his windpipe. All the usual efforts of sputtering and coughing proving of no use in getting it up again, he gave over in despair, and summoned his doctor, who, coming armed with all the instruments of his surgical case, applied them in all the various ways, according to the best skill of his art. His attempts, however, to extract the sovereign were in vain, and he called to his aid some of the most eminent surgeons of London. Consulting with these, all the contrivances they could suggest were tried, but with no more successful effect. At last, in despair of their power of doing good by any ordinary means, it was proposed to resort to the serious surgical operation of cutting into the throat, notwithstanding that they were perfectly aware of its great risk to life. After they had resolved upon this desperate remedy, and just as they were on the point of resorting to it, Mr. Brunel cried out, "Turn me upside down!" Fortunately catching at the suggestion, they did as they were bidden, and, taking the patient by the heels and lifting them up, while his head was allowed to hang down, they gave him a vigorous shake,

and out came the sovereign, rolling upon the ground.

The thing to be swallowed, once past the opening of the windpipe and fairly entered into that of the gullet, there is little danger of its being hindered in its further passage. Hasty guzzlers, however, will sometimes, in their voracity, attempt to swallow such enormous masses of food that they are too big for even the exceedingly great capacity of the gullet, and they may accordingly stick in their course. Death has sometimes ensued in consequence; but generally, in case of a stoppage, a patient, natural effort will succeed in removing it. A ramming down, however, with a probang will sometimes be necessary. This is an instrument not unlike that used for cleaning out a gun, and is made of a long piece of whalebone, with a bit of sponge attached to its further end.

A fish or any other bone or sharp hard substance will be sometimes incautiously taken into the gullet and stick. In such a case, an attempt to bring it up again will generally succeed, if the finger be thrust well back into the throat, so as to tickle it and to cause a reverse movement, as in vomiting. Swallowing, too, a morsel of

dry bread will often effect the purpose by driving down the clogging or sticking substance.

Questions.—What is the use of the incisor teeth? What is the use of the molar teeth? What is the use of the saliva? What is the use of taste? What is the use of the windpipe? What is the use of the gullet? What are the dangers of swallowing? Give an account of the accident to Mr. Brunel. How are stoppages of food in the gullet relieved?

CHAPTER XX.

Action of the Stomach on Food.—Effect of Activity of Body and Mind.—Chyme.

THE food or whatever is swallowed passes through the gullet into the stomach. Here it undergoes the chief process, if it is digestible, of digestion, which in this stage is very like, indeed, the operation of cooking. Heat, moisture, movement, and a solvent are the essential requirements of each. The stomach has in its natural heat a substitute for the kitchen-fire; in its gastric juice, a liquid which it pours out whenever its digestive action begins, a supply of both the water and salt indispensable to the purpose of the

cook, and by its constant contraction and expansion it keeps up a movement which the constant stirring of the pot could hardly equal.

As soon as the food enters, there is a rush of blood toward the stomach by which its heat is increased to the proper degree necessary for the digestive operation it has to perform. It is owing to this that so many persons feel, after eating a full meal, a sensation of cold over the whole surface of their bodies. This effect, if not excessive, may be regarded as a good sign, inasmuch as it is an indication that the process of digestion has vigorously begun. On the contrary, when there is flushing of the face and an uncomfortable sense of general warmth, it is a proof that the stomach is oppressed by some cause or other, and, not being in working order, refuses the supply of blood or heat which it would otherwise accept.

Active exercise after a plentiful meal is rightly regarded as unwholesome. There can be no vigorous movement of the limbs for any length of time without causing a rush of blood toward the surface of the body, and accordingly checking its flow to the stomach, and thus depriving it of the heat essential to its work of digestion.

Young folk are so eager to be up and at play, that though they may be, as they generally are, hearty feeders, they hardly spare a moment for proper eating or digesting. It is not essential, nor is it possible, for boy or girl to remain in a state of torpor after each meal like a gorged anaconda or surfeited sloth; but children are advised to postpone, until a half-hour at least after each solid repast, the running of races, the following of the hounds, skipping of the rope, baseball and cricket matches, and all other games and amusements which require considerable effort, and are likely greatly to heat and fatigue the body. We need hardly urge upon the children themselves the necessity of avoiding all hard study immediately after meals. Their own instinct will suggest it with sufficient force to them. Their elders, however, in whose charge they may be, will need perhaps a warning, and they are now earnestly reminded of the fact that intellectual exercise is no more consistent with the proper performance of digestion than is physical exertion. They should never set children to work at their lessons until a full hour after the solid meal of the day. When the brain begins to work, the nervous force, whatever it may be, and the

blood tend toward it; and thus, as during any physical activity, the stomach is deprived of the extra supply of both which it requires for duly performing its function.

Whatever of a more or less solid kind enters the stomach and is suitable for digestion and the use of the body, is turned into a pulpy kind of substance termed *chyme*. The time taken for this change varies with the nature of the substance which is received and acted upon by the stomach.

Some liquids remain unchanged, and pass at once from the stomach into the general system, and thus the quick action of various deadly poisons are accounted for. Alcohol may be regarded as one of these. If it does not always kill as rapidly as some others, its power is immediately shown in a way which leaves no doubt that it has begun its deadly mischief. On examining after death the bodies of persons who have died from the effects of drinking whiskey, brandy, or other spirits, the alcohol, which is the chief part of these, has been found in the brain unchanged in its course through the body. There can be no doubt that this subtle liquor is no sooner swallowed than it starts for the head, where it quickly arrives, in

spite of the long zigzag paths it may have to take, and begins at once its mischief. Quick as it goes, however, it does not fail to leave on its way harmful traces of its fatal touch. However small the quantity swallowed, the effect of alcohol on the brain is observed immediately in the excitement of that exceedingly sensitive organ, and shows itself even in the dumbest person by an unnatural wakefulness of expression, liveliness of manner, and freedom of talk. These effects are probably the chief motives which incline stupid and woe-begone folk to the use of this dangerous spirit. This excitement of the brain, moreover, by alcohol is what induces the physician to have recourse to it as a remedy in cases of illness where a sudden arousing of the nervous system may be thought urgent, as in the prostration from low fevers, fainting, sunstroke, and exhaustion from excessive fatigue. All prudent doctors, however, use this, as other poisonous medicines, with the greatest caution, and only in cases of emergency. Some physicians are so conscious of the dangers of alcohol, that they have even banished it entirely from their list of remedies.

To young people, especially, alcohol in any form is particularly harmful. Children

have been frequently poisoned to death by whiskey, brandy, and other strong drink which they have taken, heedlessly, of their own accord, or been induced to swallow at the suggestion of brutal drunkards. All spirituous liquors, of whatever kind, and however agreeable to the taste as they are often made by sugar and sirups of various sorts, must be shunned like every other poison. The essences and cordials which so often tempt the youthful palate are generally made of the coarsest spirit or strongest alcohol. Though the drinker may not be immediately conscious of the bad effects of these drinks, he will be, sooner or later, if he continue to take them; and one of the worst dangers he has to fear is the danger of the repeated tasting of them becoming a habit, than which there is none more fatal to decency and virtue as well as to health and life.

Water, too, is quickly absorbed upon being taken into the stomach, and a great quantity of it must be swallowed, either pure or mixed, for it forms about nine-tenths of the whole composition of the body.

Although the stomach is forced to receive all substances the gullet is voracious enough

to swallow, it is not always able to make use or readily to get rid of them. It has only a narrow opening called the *pylorus*, or "guard at the gate," at the end where it connects with the adjoining bowel, adapted for the passage of the half-fluid chyme. When, therefore, the stomach gets hold of something which is too hard to be turned into this soft substance, or too large to pass off with it, it is apt to remain for some time, at least, and do a great deal of mischief. A Frenchman, a few months ago, apparently very proud of his capacity of swallow, and not content with such proofs of it as he might give with the abounding beef and pudding, began to display it by gulping down jack-knives. He apparently thought that if he once got them into his stomach, it was an affair which no longer concerned him. His swallow, to do it justice, was equal to the occasion, but the stomach, alas! rebelled against being packed with such an assortment of hardware. The consequence was that he was forced to have recourse to the surgeons for aid: and, by the last accounts, these had succeeded in what they term "a beautiful operation," by which the jack-knives had been cut out of the stomach, but the patient left in an almost hopeless

state, with barely a chance of saving his life.

Boys and girls perform at times some wonderful feats in swallowing, and make, unquestionably, frequent escapes from danger more remarkable still. They may not always be so fortunate if they persist in their recklessness. Death has occurred from swallowing peach and cherry stones, and will certainly occur again; but to whom of the many young folk that persist in the dangerous practice—whether to you or another, for you are all in equal danger—who can say? There is a specimen (and others like it are to be found, doubtless, in almost every anatomical museum, for they are by no means rare) in the College of Surgeons of Edinburgh of a portion of bowel taken from the body of a child that died from a cause unknown before his death. After it, this became apparent enough, as the bit of entrail will show to every spectator who will take the trouble to look at it. The bowel is enormously enlarged beyond its natural size, and is packed as tight with cherry-stones as a winning boy's bag with marbles. It is supposed that a cherry-stone, after being swallowed, had passed, mixed with the chyme, from the stomach into the

bowel, where it caught in one of its numerous folds and stayed. Subsequently another cherry-stone followed in due course, and, checked in its passage by its fellow, which had become a fixture, it stayed too; and so on with cherry-stone after cherry-stone. For a time the bowel was able to make room for each addition to the company by extending its walls and preventing them from obstructing the passage. Finally, however, as the cherry-stones continued to come, and the bowel, having got to the full width of its stretching power, could yield no more space, the intruders filled up the channel, and so closed the way. Death, of course, was the consequence, and it only seems surprising that it does not oftener occur, and cherry-stone swallows, since they are so numerous, do not supply the museums with more abundant specimens like that in the Edinburgh College.

A young gentleman of New York died, after very severe suffering, from a cause which greatly puzzled his physicians until, examining his body after death, they found a small piece of oyster-shell sticking in a part of his intestine and perforating it. This fatal bit had probably been swallowed unconsciously in that every-day act of taking

a rapid lunch, and proves how necessary it is to avoid haste and carelessness in swallowing the simplest meal or food.

Questions.—How does digestion resemble the process of cooking? What is the effect upon the blood of the beginning of digestion? Is exercise proper after a full meal? What is chyme? What is the action of alcohol upon the human system? What are the dangers of spirituous liquors? What is the pylorus, and what its action? Give some illustrations of the danger of swallowing indigestible things.

CHAPTER XXI.

Beaumont's Experiments.—Comparative Digestibility of Different Food.—Variety.—Feeding Children.—Proper Diet for them.

THERE was a boatman, a Canadian by birth, but in the United States service, who was wounded by the bursting of a gun. A fragment passed along his side, carrying away a large mass of flesh and a part of his stomach, leaving a frightful gaping wound. He recovered, strange to say, from the immediate effects of the accident, but there was left a hole which never closed. Through this opening, though partially covered by a flap of skin, there was a free communica-

tion from without to the stomach within. A Dr. Beaumont, an ardent student of physiology, hearing of the man, and at once struck with the opportunity his peculiar condition offered for experiment, secured him for the purpose, and after a series of careful observations published the result.

The case of the wounded boatman naturally suggested a number of experiments to test the digestive power of the stomach, and to this attention was particularly directed. For this purpose, the doctor passed various articles commonly used for human food through the opening in the man's side into his stomach, and watched the effect. He was thus enabled to discover the length of time required for the conversion of each different article into chyme, the pulpy substance which is, as we know, the result of the action of the stomach upon whatever is digestible. The exact details of the results of Dr. Beaumont's various experiments it is not possible to give without direct reference to his book, the interest of which is such as to commend it strongly to the attention of every one who may have the rare opportunity of reading a work which has apparently now become very scarce.

The phenomena in the particular case of

the boatman were generally in accord with what are now recognized to be the established facts of science and experience. It was found that the time taken for the conversion into chyme of different substances varied not only with their original nature, but their mode of preparation. Vegetable food, excepting ripe fruits of some kinds, was less quickly digested than animal. The uncooked radish, lettuce, and other vegetables were much slower to be operated upon than well-boiled potatoes, spinach, and cabbage. Light bread was, of course, much more digestible than heavy pastry. The young meats, as they are termed, veal and lamb, were less speedily disposed of than the old ones, beef and mutton. White fish was more rapidly reduced to chyme than the dark, so that a bit of boiled cod was sure to disappear sooner than a slice of salmon. There was a fact established by the doctor's experiments which will strike most people aghast to hear stated, so contrary does it appear to the general opinion. Lobster was found to be one of the most digestible of foods, if not the most easily digested of all. This, however, was not that delicacy as it is ordinarily presented to the fond taste of the epicure, dressed in all the

richness of a *mayonnaise*, or tricked with the piquant varieties of the salad. The digestible lobster was plain but thoroughly boiled lobster, and nothing more. The indigestible lobster, as commonly known, owes its bad but well-deserved reputation to the crude lettuce and biting condiments with which it is ordinarily associated. The innocent fish has been judged as usual, but in its case wrongly, by the company it keeps.

A great variety in diet is not absolutely essential to supply the body with the different elements which it requires for sustaining its life, for there are single articles which contain all of them. Milk or bread, for example, possesses all that is necessary for nutrition. It is customary, however, to vary human food, and no doubt the practice, if not carried to an extreme, is beneficial. The taste and palate are to be regarded, for if their caprices are not considered, they may refuse to supply the stomach with as much as it requires for the service of the body. It is not enough that a substance should contain the nitrogen, carbon, hydrogen, and oxygen which the chemists declare to be all-sufficient for nourishing and keeping us fully alive. Food must be pleasing to the taste and satisfactory to the demands

of the appetite; and however scientifically exact the chemists prepare, measure, and weigh out the starch, gluten, and albumen, or the constituents of which they are composed, in accordance with the wants of the body, they could never be made acceptable and useful to the living being, like the more savory though ruder concoctions of the kitchen.

Young people are expected, as a general thing, to eat what is given to them for the purpose, and cannot therefore be supposed to exercise much choice in selecting their food. They, however, do manage not only at their regular meals, but during the intervals between them, to use a pretty large discretion in satisfying their appetites. Judicious parents will take care that the child's table—as, in fact, their own—should never contain anything but what is wholesome and digestible, and insist upon their children strictly obeying the rule of eating what is set before them. There is no reason why the diet of a child in its teens should differ in kind from that of a grown-up person; although the latter, if in full health and activity, will require a larger quantity of solid food. The appetite, however, of the youth is apt to be very great, and his re-

quirements, moreover, large, to supply the waste from the excessive mobility, and the material for the rapid growth of that period of life. If the food is plain and substantial, there is little necessity of checking a child's voracity. He may safely be left to roam at will over any extent of stale bread, or plunge into any depths of homely porridge and hominy, without a muzzle to appetite; the instinct of which, aided by that of a simple taste unperturbed by luxury, will prevent all likelihood of excess. Give the child, however, the freedom of the pastry-cook's shop, and he will eat and eat, cram and cram, and ask for more, unchecked by anything less than a colic or a vomit.

Questions.—What was the nature of Beaumont's experiments, and what were the results? Mention some articles of food which can support life. Is variety of food essential? What is the best food for youth?

CHAPTER XXII.

Children's Likes and Dislikes.—Idiosyncrasies.—Variety Essential to Children.—The Child's Table.

CHILDREN are apt to express likes and dislikes for this or that kind of food, which have no other basis than mere fancy. Sometimes, with the very decided protest "I can't eat *that*," they will obstinately refuse every member of the vegetable kingdom, and even scorn that most generally acceptable article, the familiar potato; now they set their teeth against flesh of all kinds, or this or that especial variety, perhaps veal, mutton, or beef, or all of them; and, again, they will not taste fish or fowl.

There are, no doubt, peculiarities of constitution — idiosyncrasies, as the doctors, with their fondness for big words, call them — that certain persons have, which not only give them an aversion to the flavor of some particular and generally acceptable food, but prevent them from digesting it. We know a gentleman who always turns away with disgust from a proffered strawberry; and if made to swallow one unconsciously

will suffer a severe attack of nausea and vomiting. There was also a lady of our acquaintance to whom the smallest portion of any kind of fish, it mattered not what, would, if swallowed, act with the promptitude and certainty of the most powerful emetic. In the latter case there was the strange peculiarity that fish was exceedingly agreeable to the taste, and was with difficulty abstained from, and only on account of the sickening effects of eating it. Such peculiarities are rare, but it is well to be conscious of their existence; for although caprice is generally the cause of the child's seeming dislike for certain articles of food, there may be occasionally a constitutional reason for it. Parents, certainly, are often wrong in urging upon a child, in spite of his strongly expressed aversion, certain kinds of diet in excessive quantity, merely because they believe them particularly healthy. They have thus been known to empty daily the salt-cellar into the unwilling mouths of their little ones, as if they were herrings, and only to be preserved from decay by that process. Salt is a very useful and essential article of diet. But living human creatures are, it is hardly necessary to say, not dead fish; and though the former are undoubt-

edly the better for a flavor of this useful substance, they do not require, like the latter, to be pickled with it. Again, it having been stated that fatty substances are useful remedies in certain diseases, many parents, with the hasty inference of thoughtless folk generally, concluded that they were sure remedies for the cure of all the ills that flesh is heir to. Accordingly, they at once began an active oleaginous course of treatment in their families, doubly buttering the daily bread, skimming the scant cream from the breakfast milk, picking at the bits of yellow fat from the dinner joint, and thrusting them down the throat of each youngster, as if he were a *blubberrorous* Esquiman. Fat, like salt, may be conceded to be, not only a useful, but an essential, part of human diet; but it is not necessary—in fact, it is unwholesome—to gorge people with it in a temperate climate, and cause it to be swallowed in such concentrated forms as whale-oil, seal-blubber, and tallow-candles, appropriate though these may be for a daily meal spread in the arctic regions. Children naturally resist such treatment with an instinct of aversion, which is a far better guide to health than the ready acceptance of parents of any cure-all in vogue.

Young folk, however, have a trick of refusing plain food which is the best for them, and indulging without stint in rich dainties. Variety is good for children as well as for older people. It is a common error of parents to suppose that a child's food must be entirely limited to two or three simple articles of diet. To exclude butter, sugar, and some of the various condiments absolutely, as is sometimes done, with the erroneous notion that they are hurtful to the young, is a mischievous mistake. If fed solely upon plain meat and potatoes, rice or porridge, milk or dry bread, their taste soon becomes wearied with the vapid uniformity, and they thus acquire a disgust for these and like articles of diet which would continue to please if they were presented to them in due proportion and variety. Children are often, in this way, prevented from enjoying and taking in sufficient abundance the food that is most wholesome for them. How often will a youngster turn away obstinately from the bowl of milk, or the plate of hominy and rice, than which there are no more nutritious and better adapted articles of diet for the young, merely because he has been satiated with their too familiar taste! It is in vain to repeat that he must take them, for "they

are good for him:" he will continue to resist, for his will is strengthened by the instinct of his appetite, which refuses to accept what the palate rejects. It is, moreover, well that he does; for food, to answer fully its purpose in the human economy, must not only be of a nutritious, but of a palatable nature.

A good deal of tact is required on the part of parents in the table-discipline, as in other branches of their children's education. Where the means and convenience will permit, the meals of the young should be apart from those of grown-up people. The repasts of the latter are, not that by any means they should be, too luxurious for the free enjoyment of children, and are ordinarily at hours unsuitable for them. The dinner of fashion, with its varied artifices so provocative of indulgence, its sittings prolonged far into the night, and excesses of eating and drinking, not to speak of the immoral effects of its examples of unchecked desire and appetite, should have no seat for the young. People of moderate means will generally have their children by the side of them at all meals, and they therefore should adapt the daily food and hours of eating it, so far as possible, to the requirements of their young com-

panions. To crowd the table with all kinds of temptations to indulgence, and expose them to the longing eyes and watering mouths of the toothsome child, and threaten him with the injunction, "Touch not, taste not," is at the best a cruelty. It, moreover, never answers the intended purpose, for the example of the older folk is a much greater inducement to indulge in the forbidden things than is their threatening precept to abstain from them. The common meal of grown-up people and children should be uniformly simple, that they may both partake indiscriminately of its healthful abundance without chance of mischief to either.

In a well-arranged, plain family dinner—and there is no reason why the simplest should not be so—the necessary varieties of food are ordinarily presented in the order best adapted for their due proportion of consumption. The most substantial and nutritious articles of diet come first, and the less substantial and nutritious last. It is true that it is customary to take the soup at the very beginning of the meal; but this, though a fluid, and apparently an exception, is, if well made, really one of the most nourishing of foods. Children are supposed to be very voraciously disposed, and it cannot be de-

nied that, under the favorable circumstances of a free pastry-cook's shop and an unlimited supply of pocket-money, they would seem to be of unbounded stomach. At a properly set meal, however, there is little fear of a child eating to excess, provided he has been taught to take the food in the order provided. He will, no doubt, if the prospect of some delicacy, revealed to him through the fondness of mamma or the indiscretion of cook, is looked forward to, be apt to scorn the immediate beef and reserve himself for the promised pudding. There is no reason why young people should be deprived of their prerogative of pie, or any privilege of dainty, if the food be wholesomely prepared; but they should be made to understand that such things are to be regarded as subordinate to the more nutritious meat and vegetables, which ought to form the main part of the dinner.

Questions.—How far are the likes and dislikes of the young to be regarded? What are idiosyncrasies? Give some examples. What is the effect of thrusting upon the young special articles of diet? How and when should young folk dine?

CHAPTER XXIII.

Regularity in Eating.—Proper Hours for Meals.—Before, at, and after Meals.—Dangers of Careless Children.

WE Americans are apt to do everything in haste, and in nothing do we show our characteristic hurry more remarkably than in the expeditious manner in which we dispose of our superabundant meals. What time is gained in this way is dearly paid for by the discomfort and ill-health which are sure to follow. Nature is not to be hurried with impunity by the impatience of man; and if pushed or interrupted, will either do her work imperfectly or stop it altogether. There is no natural function which so much requires both time and occasion for its due performance, and is so easily and so often deprived of them, as that of digestion.

A fixed time should be set for each meal, and kept with the utmost punctuality. Three repasts a day would seem, from experience, a sufficient number for most human beings in good health; and the best hours, generally, for these are eight o'clock in the

morning, one o'clock in the afternoon, and six o'clock in the evening. These, of course, might be changed somewhat to suit the different requirements of the business or duties of each person, but being once established, as they should be by daily habit, they ought not to be varied. He should breakfast, dine, and sup to-day, to-morrow, and always, if possible, at the hours once fixed. An interval of about five hours between each meal seems requisite for the completion of one full repast and the repose necessary to the stomach before beginning another.

Children are supposed to be in a perpetual state of hunger. They are certainly always ready to eat, but this is rather owing to the constant desire they have of pleasing their taste than of satisfying the cravings of their stomachs. If their palates were kept unconscious of the delights of cake, candy, luscious fruits, and other sweets, and confined to the satisfaction of plain food, they would probably show a less eager voracity. It is possible that some children, especially when very young, may require to be fed oftener than the three established meals would allow. In such cases, if there is a genuine appetite, and not merely a capricious taste, the plainest food will be the

best means of not only satisfying, but testing it. No really hungry child will refuse a roll or slice of bread. Whatever is offered during such intervals to a child, and it should be always of a simple, nutritious kind, must be given each day at the same time, and never too soon after one or before another regular full meal. The middle of the period between the two would seem to be the most proper time. The practice of munching tidbits of any kind, fruit, pastry, and sweets, at any and each moment of the day, is an exceedingly dangerous one, and not only takes away the appetite for the nutritious food of the regular meal, but weakens and irritates the stomach by keeping it in a constant state of useless activity. Children, certainly, often survive this ceaseless worrying of their digestion; but though for a long time they may seem to suffer no ill consequences, there can be no doubt that their future lives will be the shorter and more miserable for it.

People should neither hurry through their meals, nor sit down to them without a certain deliberateness and preparation. Young folk go to their dinner very much as they do to everything else, except perhaps their studies—with a rush, and will begin it with

all the flush and heat and dirt of play upon them. They are advised, not only for the sake of decorum but of health, not to intermit the preliminary washing and brushing which most decent people regard as proper on the occasion of a meal. These cleanly operations, duly performed, will afford just the time and means required for refreshing and cooling the fatigued and heated body, and, allaying the excited nerves of a youth turbulent with play, will give him that sense of ease and calmness which are essential to the full enjoyment and thorough digestion of food.

Every one should not only sit down to dinner and eat it in as composed a state of mind and body as a hearty appetite will allow, but, after satisfying this in the deliberate manner necessary for the due performance of the processes of mastication and swallowing, remain for some time afterward in comparative quietude. He need not sink to sleep or refuse to move. In fact, a nap immediately after a full meal is harmful; and though excessive exercise of mind and body is injurious, a gentle activity of both will be beneficial. The habitual rush of youngsters from, as to, the table, and an immediate plunge into the turmoil of play af-

ter a substantial repast, are unfavorable to digestion. They should check, for half an hour at least, their impulse to the rough-and-tumble of youthful sport, and content themselves during that time with the quieter enjoyment of domestic pleasure or a composed walk in the open air.

The food taken into the stomach is, as we know, turned, in more or less time, according to its kind, into a pulpy substance called chyme. This, if it satisfies the scrutiny of the *pylorus*, or watchman at the gate, passes at once into the adjacent bowel, where it is met by a flow of mixed fluid, from the liver and sweetbread (pancreas), composed of the bile and pancreatic juice. This exercises upon the chyme a peculiar action, of which it is only necessary here to say that the result is a separation of this substance into two parts. One of these is the chyle, which may be regarded as the very essence of nutrition, for it contains those elements of the food which supply the chief means of supporting the living body. For this purpose, it is absorbed by certain vessels and mixed with the blood which in its perpetual round conveys its various nutritious elements to the part of the animal system where each is wanted. When the

chyle is taken away from the chyme, there is little left but waste matter, which, after parting with the small portions of nutritious substance it contains during its long passage through the whole extent of the bowels, is finally cast out of the body.

Of the course and disposition of the chyle when once formed we have no control ; over those of the waste matter our will has more power, and this may be exercised beneficially or otherwise, as we may be inclined. Habit in this as in other half-voluntary functions of the living creature has great influence. It is therefore strenuously urged upon all persons to establish as early as possible, and persist in, the practice of making a regular effort each day to get rid of what is evidently intended to be so disposed of. Children are particularly careless in this respect, and will even resist an unmistakable call of nature rather than take the trouble to answer it, or lose a moment of play. They thus often seriously and permanently injure their health, while, at the same time, it is the cause of much of the discomfort and disorder of which pining children so often complain. The call of nature, though it may be temporarily unheeded, becomes at last so urgent as to be irresistible ; but now

it exacts a penalty for past disobedience, and pain and disease are the consequences. Severe attacks of colic and diarrhœa are frequently to be traced to a neglect to perform regularly and habitually this important natural function, and a very serious ailment well known to surgeons as common to children has no other cause than the costiveness and straining attributable to it.

Questions.—How many daily meals should there be? What are the proper hours for meals? Should anything be eaten during the intervals between the meals? What is the proper preparation for a meal? What is proper after a meal? What becomes of the chyme? What is the chyle? What can you say about the waste matter?

CHAPTER XXIV.

The Muscles.—Their Nature and Action.—Exercise.—Its Effect on the Muscles.—Muscular and Fat People.—Cure for Fat.

THE flesh, as we ordinarily call it, of our bodies is mainly formed of what the anatomists term "muscles." The purpose of these is to produce various movements, most of which are under the entire control of the will, some only partly so, and a few not at

all. The arm and the leg have muscles of the first kind, which are moved, as we know, at our pleasure; as, for example, in the familiar actions of striking and walking. The throat has muscles of the second kind, which are put into motion in swallowing—a process at one time voluntary, and at another involuntary; and the heart has muscles of the third kind, which act altogether independently of the will, in that pulsating movement which is made conscious to every one who may place his finger on the pulse at his wrist, or his hand to his side.

Muscles are bundles of fibre or thread-like tubes which have the power of shortening and lengthening again when in a state of action, and fulfilling their purpose of movement. Those of the body with which we are most familiar are fastened at either end by means of tendons, of a tough, unyielding substance, to two different bones, and, when the muscle shortens, or contracts (the bones being movable by means of their joints), are brought closer to each other. When the muscles, on the other hand, lengthen again, or expand, the bones are drawn apart. The opening and shutting of the hand, which can only be done by the lengthening, or expansion, and the shortening, or contraction,

of its muscles, will give a familiar illustration of these actions.

What is ordinarily meant by exercise is merely putting into motion the muscles which we can move at our will. In walking and running, boxing and wrestling, and in most active sport, there is a constant muscular expansion and contraction. The effect of such exercise is very apparent upon the muscles, and very advantageous too, though the benefit is by no means confined to them alone. The frequent use of a muscle tends to enlarge and strengthen it, and thus endow it with a greater power of fulfilling its purpose. Look at those laborers stripped to their work, who are ever wielding the pickaxe and sledge-hammer. What brawny figures they have! What bull-like necks! What surging chests and mighty arms, of a mould hardly less firm and a substance hardly more yielding than the iron instruments which they use as deftly and easily as if they were parts of themselves! The bulk and strength of the laborer come from the development of his muscles by constant use; and the same force and fulness can be secured by any one in good health by similar means.

The shrivelled shanks and the dangling

arms of skin and bone of the lazy loungeur at home are the natural results of letting the muscles shrink away for want of use. He has neither roundness and fulness nor activity and strength, as he has not the muscular flesh which can alone supply them; and to get this he must give up doing nothing and take to doing something. He must put his muscles regularly and habitually into motion, or they will never be of much value when required for service, even if they should be able to make an appearance if called upon.

There are certain muscles possessed by the human creature, in common with many other animals, the function of which is unknown to most people, and whose existence is barely made conscious to the minute observation of the anatomist, so greatly have they been obscured by general disuse. That which lies under the scalp, and those little ones which surround the ear, are some of these; and let any one who has never tried before attempt to use any of them, and he will probably find that he has little or no power to put his will into effect. There are some few persons, however, who can move the scalps of their heads with as much ease as a horse does his skin, and their ears with no less facility than he and an ass do theirs.

In London, there is an old institution called Christ's Hospital School, the pupils of which, in accordance with the will of the founder, are obliged to wear the costume worn by boys hundreds of years ago. A part of this antiquated dress is a little cloth round cap, ordinarily termed a muffin, which barely rests upon the top, with the slightest possible hold of the head. It has been from time immemorial a practice with the lads of the school to throw off this light head-piece without the aid of their hands, or moving their necks. This can only be done after much and habitual effort, which, however, finally becomes successful. The action is performed by means of the movement of the muscle under the scalp, which few people know they have, and fewer still can use, although it works so readily and efficiently at the will of every Christ Hospital boy. In addition to this, he generally possesses the accomplishment of ear-moving; for in practising the one, he is led, from the natural connection of the parts, to attempt the other, and thus becomes an adept in both. Muscles which before were powerless and barely existed, in fact, thus rise, after persistent exercise, into strongly developed and active agents of motion.

Fulness of bodily size by no means, however, implies largeness and strength of muscle. Those who are ordinarily termed fleshy should be called fatty people, for it is fat, not flesh or muscle, to which their bigness is generally owing. A person swelled to an inordinate roundness and evenness of form is seldom of muscular development, which is generally shown, on the contrary, in compactness of structure and irregularity of surface. Little exercise and much feeding will produce a great deal of fat, which soon wraps the whole body in its soft folds of blubber, and leaves no space for flesh or muscle, and even turns it, if it should exist by chance, into its own substance. A very fat person will have weight, but no force. He may thus have a great burden to carry, and very little strength to bear it.

Young people of a good natural constitution and vigorous appetite, if by any means they are prevented from taking their part in the active life of youth, are very apt to become excessively fat. This is by no means a safe condition for a child, and an effort should be made at once to change it. If inclined to be a loungeur at home, as he generally is, the disposition must be checked by turning him habitually into the play-ground

with his fellows, that he may be stirred by their rude companionship into briskness of life and movement. He must be tossed and tumbled, until the softness of his fat is squeezed out, and the laziness of his bones shaken off. He must, moreover, not be treated too delicately at home. He should be substantially but not richly fed. His appetite must be satisfied with abundant supplies of plain food, but not solicited by frequent offerings of dainty tidbits. His diet should consist mainly of stale bread, meat, hominy, or oatmeal and milk. He must be kept on a small allowance of the habitual sugar and a still smaller one of the extra sweets, such as cakes and pastry. He should both go to bed and rise early, and be allowed to lie only on a hard mattress and under coverings warm enough, but not too heavy or close.

Girls have a greater tendency to become unduly fat than boys, for they get less chance of exercising their bodies. That they may have softness, plumpness, and delicacy, which are so much valued in ladies of the prize-animal kind, as George Eliot terms them, they are penned up, and pampered with food like porkers. Superfluous fat is, however, if more becoming, as some folk

seem to think, not less harmful to the girl than the boy; and if she desires to be healthy and strong, she is advised, as well as he, to get rid of it by eating less and exercising more.

Questions.—What do the anatomists call the flesh? What are the muscles for? What are the different kinds of muscles? How are muscles composed? How do muscles act? Give an illustration of the action of muscles. How do the muscles act in exercise? What is the effect of exercise upon the muscles? Give illustrations of the effect of exercise and want of exercise on the muscles. How do fat people differ from muscular? What is the proper treatment for too much fat?

CHAPTER XXV.

Natural Exercise.—Checks of Gentility, Dress, and Fashion.—Precocious Fine Ladies and Dandies.

THE best muscular exercise for young children is the movement to which they are led by their natural playfulness. They, if left to themselves, will run, tumble, and toss and wrestle with each other like sportive kittens. Each limb and every muscle of their bodies will by turns, and with the quick and easy change of water stirred by the varying breeze, rise and fall, swell and

contract, and perform all the actions of which they are capable. They are hardly at rest a moment, and each movement they make is of the freest and most graceful kind. Nothing can be more favorable for the just development of the muscular system, and, in fact, for vigorous growth and sound health, than the motions of a child in the free indulgence of its playful moods.

Parents, however, are very apt to check the instinctive movements of their children, and thus unwisely deprive them of the natural and most effective means of graceful and healthy development. Sometimes it is a timid anxiety lest the child should hurt itself which causes an officious vigilance, that is always on the alert to see danger in each enterprising effort of the child, and to check the execution of any eccentric gambol, however innocent. Accidents will certainly happen to children occasionally, as to others; but that their occurrence is not at all in proportion to the estimate of anxious mothers is pretty clear, from the constant increase of the world's population of men and women.

Overstrained notions of propriety on the part of the would-be genteel mother are also allowed often to interfere with the natural

movement of the child. Augustus must shy the posts, turn neither to the right nor left, hold up his head, and behave like a gentleman; and Ann Eliza not run like a rude street boy, but be a little lady, and walk nice and straight. With these and such-like injunctions, children are often fixed into a rigid form of deportment which is as preventive of natural movement as the village stocks, where it was customary to stick a sheep-stealer or other offender fast by neck and heels. Children, certainly, should be taught to conduct themselves in a quiet and orderly way, and even learn to walk straight and sit still, when the occasion requires such formal decorum. They must, however, be also allowed a large liberty of movement, and not enjoined to be ever holding up their heads, stiffening their attitudes, and setting their steps, as if they were undergoing a perpetual military drill.

The child, perhaps, is made to suffer more from the finery of dress than any other cause. A mother seldom dresses her children to suit their taste and promote their comfort. She tricks them off in the latest style, as she does herself, to show to the world how conscious she is of every caprice of fashion, and how able she is to spend the money

required for following it. Children themselves, though they soon ape the folly of their elders, and will become very knowing about the cut of a skirt or the fit of a jacket at an early age, are naturally very indifferent to dress of any kind. If left to the guidance of their own sense of comfort, without any hint from fashion, they would scorn all the devices of the milliner and tailor, and prefer to wear only such easy and rude covering as might be necessary to protect them. The dress of children should always be made so light and loose as to admit of the freest movement of every muscle and part of the body. There should not be any of those constrictions of form and disproportions of weight which seem inseparable from the costumes of fashion. Tight hats, tight waists, tight sleeves, tight garters, tight shoes, and tight collars must be shunned, together with padded bosoms, over-weighted bustles, and dragging skirts.

The finery of dress is, moreover, a great clog to the free action essential to healthful development. Fine silk and superfine broadcloth are too costly to be exposed to the rough-and-tumble and rapid wear-and-tear of youth, left to its natural boisterousness. A child perked up with its spread of starch-

ed petticoat, puckered flounces, and streaming sashes is hardly more capable of movement than the butterfly of the naturalist's cabinet with a pin through its middle, and a coat of varnish upon its body and wings. Rude handling, moreover, would be no more safe for the one than the other. This ridiculous practice of clogging the child with stiffened and expensive finery makes it only fit for the show-case. It is painful how the mere vanity of making a display in the eyes of the foolish admirers of fashion is allowed to deprive childhood of the essential requirements of its nature. Mark the constraint of the little master and mistress in their "best!" Watch the eye of the ever-anxious mother alert to detect the least variation from the perpendicular of her dressed-up children, and listen to the ceaseless injunctions with which she strives to impress upon their grovelling minds the horrors of a momentary contact with a bit of earth or spear of grass! "Don't run, Tom! don't run, I say! you'll fall and dirty your new knickerbockers!" "Come off that meadow! come off at once, Ann Eliza, or you will soil your nice dress!" A child thus fettered with the bonds of fashion, enclosed within the limits of a narrow propriety, and ever

watched, guarded, and warned, is as much deprived of its natural liberty as any convict dragging his ball and chain in a prison-yard.

Young people, moreover, when they are old enough to be allowed to have some control over their mode of dress, are apt, of their own accord, to choose it of a kind and make too costly and fashionable. Thence come the precocious fine lady and dandy of the *salon* and parade, who, tricked off in the motley of the fools of an older growth, and aping their manners, seem to be so many youngsters getting up, as youngsters will, a laugh at the expense of their elders. They are unfortunately, however, quite in earnest, and are by no means expecting the smile of amusement, but the gaze of admiration. The premature fine lady and dandy are very far, however, from deserving to be encouraged in any way. Dress has a great deal to do with the habits of life, and it is quite impracticable for children to clothe themselves as fashionable men and women, and act physically, at least, as children should. So long as the young are undergoing the process of growth, it is absolutely necessary that their bodies should have perfect freedom of movement, and this is hardly possible with the

prevailing modes of fashionable dress. The male garments in vogue, with their more or less sack-like form, are not so unfavorable to that ease of carriage and action essential to youthful development. What, however, can be more inconsistent with freedom of bodily movement than the present or any other style of female dress which Fashion has ever prescribed since her sway has been acknowledged? People of mature growth may burden themselves, if they like, with the latest inflictions of the fashionable milliner and dress-maker, but the more tender limbs and less resisting bodies of the young must not be pinched or crushed by their various devices of torture. The active exercise which is essential to the full and sound development of the girl, as of the boy, is not compatible with the constraints of fashionable costume. Fancy a woman making an attempt to run with the flimsy structure toppling on the summit of her head, her waist immovable, her lower limbs barely able to wriggle within the tight-drawn skirt, and her unsteady heels clogged at every step with a train draggling in the dirt! The very idea is absurd, and yet girls hardly in their teens are dressed in every respect like such women; but, of course, they can-

not be, and are not, expected to run or take any other active exercise, however necessary it may be for graceful and vigorous growth.

The mere fear of spoiling the fine suit prevents the precocious exquisite from taking part in the games and various sports, more or less rude, of the young. With the dress comes also an affectation of the manners of the fashionable world, and the exclusiveness which disinclines to any fellowship with those of plainer appearance and tougher temper.

Questions.—What kinds of exercise are the best for young people? How do parents sometimes interfere with the natural exercise of their children? Why do parents interfere with the natural exercise of their children? How does dress affect exercise?

CHAPTER XXVI.

Formal Exercise. — Long Walks. — Skating. — Swimming. — Riding.

Boys and girls seldom submit very willingly to any formal system of exercise. They much prefer to run, toss, and tumble, at their own free-will, away from the watchful eye and directing hand of parent or

guardian. Left to their natural impulse to activity, they will take plenty of exercise, and it is surprising how much they can bear without any sense of weariness. In the companionship of lively comrades of their own age, they will go through a prodigious quantity of play and exert more muscular force than would be required for any hard day's work, without even the consciousness of an effort. They feel no fatigue of limb or body, for they have exercised them in the freest and most natural manner, and their physical strength has been constantly kept up by the buoyancy of minds ever filled with interest and delight. Let them, however, be tried on a walk, for example, by the side of any older and unsympathizing companion, and they will soon show signs of fatigue, and give out long before they have exerted a muscular force equal to that of a five minutes' run in the play-ground.

The formal walk to which children are made to submit, as in the "walking advertisements" of the fashionable school, or when dragged at the skirts of the anxious mother, may be better, perhaps, than no exercise at all, but is by no means an efficient substitute for the spontaneous activity of childhood left free to indulge its own play-

fulness of humor. The practice so common with fathers, mothers, and nurses to lead very young children by the hand on a walk is apt to be a hurtful one. The older person, with the best intentions in the world, can hardly adapt his steps to the toddling ones of a young child, and does not always think of making the attempt. The consequence is that the little charge is either forced to strain its strength to an unnatural and dangerous degree in order to keep up, or is dragged along with its tender limbs stretched almost to tearing, and its feet and ankles bent back to breaking. The torture is made obvious enough by the fretful complaints and loud cries of the child, which, however, many people are so stupid as to attribute to ill-temper or to any other than their real and evident cause. Many a poor little creature is thus forced to suffer doubly, being not only made to cry, but punished for doing so. Children when taken out for exercise, if they cannot, for some good reason or other, be left entirely to themselves, should be allowed to go at their own natural pace, and never be forced to keep up with the strides of a full-grown person.

Young folk seldom, if ever, are injured by too much play, however boisterous or long-

continued; but their strength is sometimes permanently weakened by lengthened walks. Growing youth, emulous of the vigor of more mature persons, will attempt feats of pedestrianism quite beyond their powers of endurance. The strain to which they are subjected in a long walk is of too uniform a kind, and is not sufficiently relieved by either variety of motion or interest, to be easily borne by the tender muscles and impulsive feelings of the young. Their whole system is full of activity and animation, but there are wanting that toughness of fibre and firmness of resolution essential to a steady effort in one direction of either body or mind. The hardest of the play-ground whose spirit and strength never flag in the ever-varying and recurring game may soon break down in the continuous stretch of a few miles' walk. Youth, until it has reached its full development, or "done growing," as it is termed, will find in the ordinary outdoor sports of childhood the most healthful means of exercise; and any attempt to shirk them, and, with an idea of mannishness or womanishness, to substitute those of more mature people, should be checked.

Skating is one of the best possible of exercises, for its movements are easily control-

led by the will and adapted to every varying strength, while its excitements are equally pleasurable to all, both young and old. It has, moreover, the advantage of impelling to out-door exercise by its irresistible invitations during a season when most people would be inclined to hug the fire at home, and thus deprive themselves of that active muscular movement so essential to health at all periods of the year. Young girls are especially benefited by the adoption by fashion of skating, for if it were not for its permitted enjoyments they would hardly take any exercise out-of-doors at all during the whole winter. Those who venture on the ice will occasionally break through this proverbially hazardous support. In case of a slight wetting, it will be best to continue the skating, if practicable, to prevent any chill to the body which would follow the sudden cessation of exercise. If, however, the skater should be so unfortunate as to get a complete ducking, he should have any dry woollen garment at his disposal thrown over him, and he be hurried home on a *run*, or to the first house at hand, where his clothes should be changed and a cup of hot tea administered to him as soon as possible.

Swimming, besides its obvious advantage

as an additional security to life, is one of the best forms of exercise. Its motions are regular and general, bringing every muscle of the body into easy and uniform action. Though there is considerable difficulty in overcoming the first dread of the water, and, in consequence in acquiring the elements of swimming, there is nothing which, once learned, gives more pleasure to children than this art. Parents and teachers should make it an essential branch of study, as it is of education, and supply proper means of instruction. All boys and girls can and ought to be taught to swim. A dozen lessons, earnestly and patiently given by a competent instructor, will be enough to make any youth of either sex sufficiently confident of his or her power, and conversant with the art to pursue it to perfection without further aid. Most youth, however, require the preliminary instruction, for few, if left to themselves, will be capable of the effort necessary to overcome the dread which makes the inexperienced shrink from every watery deep. If swimming should not be acquired before mature life, or even advanced youth, it will probably never be acquired at all, for it is rarely that either men or women, when full-grown, learn the art.

There are certain well-established rules which a bather or swimmer cannot disobey without risk to his life. He must never enter the water immediately after a hearty meal. He must not plunge into the cold water while excessively fatigued and heated with exercise. The practice, however, of stripping off the clothes and cooling the body by exposure to the fresh air is not a good one. The body, if fatigued and heated, is most safely refreshed and cooled by a gentle saunter in the shade before undressing. The cramp, so common in swimming, is best remedied by a sudden change of posture, and generally that on the back, while floating at full length, is the most advantageous.

In a case of apparent drowning, when the body is extricated it should be turned over for a moment in such a way that any water it may contain may pass out of the mouth and nostrils. It then must be laid on the back, with the head slightly raised and the lower part of the body and the legs covered as warmly as possible. Now an attempt should be made to restore the power of breathing by blowing from the mouth of the operator into that of the person operated upon, and at the same time raising with

both hands of the former the whole chest and arms of the latter. This blowing should be alternated with regular pauses, during which the chest and arms should be brought down. In this way the natural action of respiration is imitated; and if patiently continued, life may be restored. Rolling on barrels and kneading or pounding are cruel barbarities, which are pretty sure to crush out every chance of recovery.

Horseback exercise has every advantage but its costliness. There seems no reason, however, why it should not be made more available for the general use of youth than it is. In schools the supply of a few horses or ponies, and a division of the expense among all the pupils, would give each, at a very small cost, the opportunity of learning that most excellent art of horsemanship, as it has been justly called. There is nothing that more delights the imagination of the young than the idea of the mastery of a steed of some kind or other; and consequently there is nothing to which they take more kindly than horseback exercise, while there is none better for animating the spirits, bestowing grace, and developing strength. There may be timidity at first, but this is very soon overcome, and in a very brief

time the youngest child will learn to sit gracefully on a horse and easily control it. Riding, like swimming, must be acquired in youth, or all hopes given up of ever after mounting with safety or striding with grace the gentlest animal that trots.

Questions.—What kind of exercise is best borne by the young? How do long and formal walks affect the young? What is the advantage of skating? How should the skater act after a wetting by breaking through the ice? What is the advantage of swimming? How is cramp to be treated? What is the proper treatment for drowned persons? What is the advantage of horseback exercise?

CHAPTER XXVII.

Postures.—Standing.—Sitting.—Lying Down.—Sleep.

STANDING, sitting, and lying down are such familiar processes that it might seem quite unnecessary to give any instruction as to their proper performance. Nature itself, it might be supposed, should be a sufficient guide to direct human as other animal beings when and how to assume such simple postures of rest as are most conducive to their comfort and suitable to the organiza-

tion of their bodies. So perverse, however, are the ways of man, and of his youthful offspring especially, that he and they are always wandering from the natural paths plainly pointed out to them, and following the artificial tracks of some irregular fancy or obstinate ill-habit.

The graceful and healthy development of the body may be seriously deranged by the habitual postures taken while standing. Young folk, when forced by any cause to keep on their feet for a long period and hold themselves, as they best can, in a fixed position, are sure to yield to some distorted action of body. This soon becomes a habit, and will not only destroy grace, but injure health. Look at a class of school-boys called to their feet to recite a lesson, and mark with what precision they heed the severe command of their master to stand still, hold up their heads, and keep perfectly silent, while each of their comrades slowly plods through his long task! The poor lads, with the fear of the ever-impending birch, will do their best; but, strive how they may, there is not a limb, a hand, foot, or movable part that will not make good its natural claim to liberty of action by some motion or other. This being under constraint will

take the most grotesque and distorted forms, such as the wagging of the head, the swinging of the body, the twisting of the legs, the shuffling of the feet, the snapping of the fingers, the scratching, the winking and grimacing, and the coughing and spitting, which seem to be special functions of every school-boy. Teachers would do wisely to take a hint from the drill-sergeant, who is careful never to tire his raw squad of recruits by a too long and uniform posture. He is ever varying his commands—"Right face!" "Left face!" "Right about face!" "Present arms!" "Shoulder arms!" "March!" "Halt!" etc.—and does not forget to impose frequently the important and welcome order, "At your ease!" Lads at school should be treated in the same humane way, and never be required to attempt the impossibility of remaining motionless in one attitude for an indefinite length of time.

Boys and girls, when they do stand, should plant their feet, slightly apart from each other, solidly on the ground, and let their arms, if disengaged, fall naturally by their sides. They should avoid all wriggling of body, and grotesque movements of their limbs and hands or features. Standing on one foot, and throwing the weight of the body upon

its leg, while the other leg is bent or twisted, and only supported by the ends of the toes of the foot just touching the ground, is a common habit with young people, and frequently produces permanent distortion of the frame. All awkward and constrained postures should be avoided, and the position in standing must be varied naturally and whenever a change is suggested by a sense of fatigue. Set attitudes, if attempted to be kept for too long a time, will be sure to shift into awkward and irregular actions, which, when continued, finally settle into ugly habits and permanent deformities. Habitual exercise of the whole body, in accordance with the natural impulses of flexible youth, is the best means of securing grace and regularity of growth. No dancing or posture master will be able to endow a youth who is habitually deprived of freedom of muscular movement with the ease essential to the healthy and proportionate development of the person.

According to Lord Monboddo, an odd Scotch philosopher, human creatures were originally monkeys, who lost their tails by the habit they had acquired of sitting down. The awkward manner in which this simple process is often performed would almost

seem to confirm the notion of his lordship that it is not natural to man. There are not many people who are able to sit down properly on a chair. Most will place themselves on its edge, so gingerly as to make one suspect that there must be still a remnant left of the original tail, and wriggle about in a way that confirms the suspicion of the monkey nature. No seat should be without a back, and when a person places himself upon it for rest, he should sit solidly and fully down, covering well the bottom of the chair, or whatever it may be. The back of the sitter must rest against that of the seat, and his legs be allowed to assume an easy half-bent position, while his arms should recline without restraint.

Children seldom, while sitting at a table, have their chairs close enough to it. They consequently sit too far forward, and are unable readily to rest their backs. It is thus that they sink into a crouching attitude, with the head hanging, the shoulders rounded, the chest contracted, and the spine curved in a manner very unfavorable to healthy and graceful development. The child, too, is often seated at a table too high for him, and is thus forced to raise his arms to an unnatural height, by which his shoul-

ders are made to assume, as it were, a perpetual shrug. Some of the ugliest deformities of the young are due to no other cause than the neglect of the simple precaution of raising their habitual seats to the height of tables adapted only to full-grown people. In writing or reading at a low table or desk, there should be means of raising the book or paper so high that it may not be necessary to bend the body too much, or remove it too far from the support of the back of the seat.

Lying down should not be indulged in by young folk, at least except when ill or prepared at the proper time to go to sleep, and then the suitable attitude to take must be left mainly to nature. Something can be done, however, by every one toward rendering the night's repose both refreshing and healthful. The sleeping-dress should never consist of any article of daily wear. The fresh night-gown should be worn, and nothing else, and this ought to be long and full, without any tightening about the neck or wrists. In bed the sleeper should acquire a habit of lying on the left side, as the heart, which is somewhat movable, is in that part of the body, and will thus remain more readily in its natural place; while if he lie

on the right side, it will shift its position, and, pressing upon the lungs, interfere with the freedom of breathing. The pillow should be broad, and high enough to support and raise not only the head, but shoulders. The bed ought to be of horse-hair or some porous and elastic material, and never of feathers. The best covering is the cotton sheet and woollen blanket. *

Young people want a great deal of sleep. An infant is seldom awake; a child of two years of age ordinarily requires two or three hours of sleep during the day, and twelve hours at night; and most children beyond this age, until they have reached their teens, should have ten hours out of the twenty-four of sound slumber. Eight hours are about the average time taken and required by more advanced youth and those of full growth.

When some one exclaimed to the Duke of Wellington, on being shown the narrow camp-bedstead on which he habitually slept, "There is no room to turn about in it!" the Iron Duke answered, "When a man begins to turn about in his bed, it is time for him to turn out." The habit of remaining in bed, after a full night's sleep, is an unhealthy one, especially for young people. They should get up as soon as they awake

naturally, and never linger to invite a second nap, or to turn about in the soft, warm embraces of the heated bed, but turn out at once. Early rising is the best for children, for it implies going to bed early, and sitting up late exposes them to the social excitements of the evening, which are inseparable from the companionship of older people, and calculated so to work upon the delicate sensibility of a child as to disturb his whole night's rest.

Questions.—How does the habitual posture affect the body? Give an illustration of the bad effect of long fixed postures. How should boys and girls stand? How should we sit in a chair? How should we sit at table? What are the proper postures on lying down to sleep? What number of hours is required for sleep by persons of different ages? What is the advantage of early rising?

CHAPTER XXVIII.

The Five Senses: The Eye; Ear; Nose; Taste; Touch.
—Use and Abuse of Organs.

SIGHT, Hearing, Smell, Taste, and Touch are what are called the five senses. The three first have each special organs, by means of

which they exercise their peculiar power. The sight has the eyes; the hearing, the ears; and the smell, the nose. The taste, though it is served chiefly by the tongue, has not the exclusive use of this organ; and touch is a sense common to all parts of the living body.

The eye is a beautiful structure, wonderfully adapted to the purpose of forming and receiving an image of every external object brought within its range. This image is essential to the sight, but does not constitute, of itself, the sense, for that depends upon the nerves and brain. Without the eye no image will be formed, and even with it, if by any reason the nerves and brain are unable to perform their part, the image, though it is formed, will not give the sense of sight.

The mechanism of the eye has been imitated by various ingenious human contrivances by which images of objects can be formed as by it. The several parts of the eye are no less necessary to its purpose than those of the different machines made by man to imitate it. Derangement or absence of a glass or other necessary portion of the telescope, camera, or any optical instrument, will either render the image imperfect or

prevent entirely its formation. The same effect will be produced in the eye by similar causes. If any essential part is disordered or destroyed, there will be either an incomplete image or none at all, and consequently the sight will be imperfect or totally lost.

The eye, therefore, should be carefully guarded against every possible danger; for though the skill of the oculist may do something toward remedying the effects of injury, it can seldom restore the organ to its original perfection, and never renew any part of the mechanism, once destroyed, as is always easily done by the optician in the case of his deranged or damaged instruments.

The eye itself is fortunately very vigilant, and winks at every approach of danger; though its winking, so far from being the seeming indifference generally understood by the word, is an evident effort for self-protection. The quick movement of the eyelid, which shuts at the least suspicion of harm, is, no doubt, a great security to the eye. It is thus that it escapes so frequently the imminent risks to which it is exposed, particularly at the hands of reckless youth. The eye, however, even when

covered by the eyelid, may not only be seriously injured, but entirely destroyed. Boys should never, either in anger or play, aim a blow of any kind at or in the direction of the eyes. Though what is ordinarily termed a black eye is generally the only result, a smart shock from a strong lad's fist is enough sometimes to destroy the sight forever. A melancholy example of total blindness is known, which is due to a fatal injury to each eye at different times from blows given by a brother, and under circumstances indicating no more than the usual spite and violence of a fraternal tussle. The eye, moreover, vigilant as it usually is, is sometimes thrown off its guard and fails to drop its protecting shield, especially when exposed to a side or indirect attack. In such a case should the ball of the eye be struck, even in the lightest manner, especially if by any sharp thing, it will probably be seriously or fatally wounded.

Short-sightedness is often a natural infirmity, but is not seldom produced in youth possessed originally of perfect sight by the habit of bending the head low and bringing the eyes too close to the object looked at. This habit is very apt to be acquired by school-children when seated on benches

without backs, with their books, slates, or writing-paper placed on low tables and desks, which allow of the upper part of the person crouching and lounging upon them. A slanting rest of some kind should be used, and be made so high that the reader or writer may engage in his occupation with the body but slightly bent, and within easy reach of the back, which every seat should be provided with. When there is confirmed short-sightedness, whether from natural or artificial causes, the only remedy is a pair of spectacles with concave glasses, and these should be used constantly, as soon as the defect of sight is obvious, even at the earliest age.

Another bad habit common to children is that of persisting in reading during the last moments of the day. They will frequently keep their eyes close to their books when it is too dark for any but those of their sharp sight to see a letter, and, when this is no longer visible even to them, go to the window to catch a departing glimmer of light to continue their reading. This is a very bad practice, and young folk should avoid it by all means, for the strain to which it puts the eyes is exceedingly dangerous, and will be sure to weaken and permanently in-

jure the sight. There should be no attempt to use the eyes in reading, writing, or, in fact, doing anything requiring exact vision, without a full sufficiency of light.

Children will sometimes stare at the sun with open eyes, as if to show, from mere bravado, how long they can face that brilliant luminary without blinking. Immediate blindness has been the result of this foolish freak, and it can never be safely practised.

Young people should be careful, as soon as they rise from bed in the morning, to wash their eyes clean from the matter which always accumulates on the edges and in the corners of their eyelids. This, moreover, should be done by sopping rather than rubbing, so that the eyelashes may not be irritated or torn from their roots. Weeping may sometimes be a necessity, and is undoubtedly occasionally a relief, but it should never be practised without sufficient cause. Children should check as far as possible their tears, for they are irritating and injurious to the eye, especially when their flow is forced by a strain of the feelings aided by the punching and squeezing of dirty knuckles.

The eye should always be well opened

when viewing any object, and scowling, casting side and under glances, and looking askant avoided, for they are apt to cause short-sightedness and the ugly deformity of squinting. "Let thine eyes," says Solomon, "look right on, and let their eyelids look straight before thee."

When anything gets into the eye, it will generally, if movable, be found under the upper eyelid; and to remove it, this should be turned up, as is easily done, and the offending particle wiped off with the end of a clean finger or the corner of a handkerchief. In rubbing the eye, if it be done at all, it should be always toward the nose. A good blowing of this will at the same time facilitate the escape of any irritating object with the flow of the tears through their natural outlet into the nasal organ.

The most delicate and important parts of the machinery of the ear are fortunately so well protected in a bony case within the head that they cannot easily be damaged by the most reckless. The outer opening, however, of the ear leads to a part of the apparatus called the drum, which is not very difficult to reach. It is proper, therefore, to warn children against all attempts to penetrate with a straw, or anything else,

in fact, in that direction ; for this drum is a thin membrane tightly stretched, which can be easily pierced, and if thus or otherwise injured, may cause much suffering and serious mischief, resulting perhaps in the entire loss of hearing.

The nose, probably from the facility it offers to intrusion from its exposed situation and ever-opened doors, is more apt than any other organ to be interfered with by the busy finger of youth. Apart from the disgust which the picking of the nose excites in every looker-on, the practice is a harmful one. The constant fumbling of it with the fingers enlarges and coarsens its structure, and so thickens the membrane which lines it that its sense of smell loses all its delicacy, and becomes unfitted for the nice discrimination of odor for which it is designed. The voice, moreover, is disagreeably affected in consequence. Ugly ulcers are sometimes caused by habitual picking of the nose, and are always very difficult of cure.

Young people should not bite their lips ; for this is not only an ugly practice, but it thickens, greatly disfigures, and often makes them sore. The Marchioness of Pompadour, the favorite beauty of Louis XV. of France, first began, as she herself confessed, to spoil

at the mouth, in consequence of her indulgence in this bad habit.

The practice of keeping the mouth closed except in eating, drinking, talking, and in the performance of other necessary functions, is a good one for toothache and many other disorders, and some serious diseases will thus be often avoided. By breathing through the nose rather than the lips, there is less chance of the entrance of cold into the mouth and lungs, and of an infected air, by which some of the most dangerous maladies are conveyed into the body. The fixed habit of keeping the mouth closed during waking hours will moreover prevent, when asleep, the practice of snoring, so annoying to fellow-slumberers. Children, too, should carefully abstain from making pen-wipers of their mouths, for which, or anything of the kind, they were evidently never intended.

The tongue should be kept generally within the range of the teeth. The habit of thrusting it out between the lips is a vile one, and, besides, prevents distinctness of speech. The taste depends much upon the condition of the mouth and stomach; and it is essential that these should be kept in good order, that it may retain its purity and be able to administer, as is de-

signed, to the pleasures and uses of the living being.

The touch is so little dependent upon human control, that young people are not likely to be benefited by any special directions in regard to it. Parents, however, should be reminded of the acute sensibility of children, and particularly of infants. A great deal of discomfort is often caused by subjecting the sensitive skin of the young to immediate contact with coverings of harsh material. The fleecy woollen and soft cotton are the least irritating, and should be generally used, for under-wear at least. Excessively starched articles of dress are calculated, when worn by young people, to make them very miserable; and much fretfulness of mind, and even feverishness of body, is often due to no other cause than the washer-woman's too free use of the starch-bowl.

There are others besides the organs of sense which are more or less under human control. Some of these are the most important of the body, and any perverted use or abuse of them in childhood will be fatal not only to the special organs, but to the whole life, physical, moral, and intellectual. They are intended for a great and obvious

purpose, which can only be fulfilled in the maturity of age; and all youth are solemnly enjoined to abstain from any premature and irregular exercise of their functions.

Questions.—What are the five senses? What are the organs of the five senses? What is said about the eye and its dangers? How does the eye protect itself? How is short-sightedness often produced? What is the best remedy for short-sightedness? What are the dangers of an imperfect light? How should the eyes be cleansed? What is the effect of much weeping? How is anything which falls into the eye to be removed? What are the dangers of the ear? What are the dangers of interfering with the nose? What is said about biting the lips? What are the dangers of keeping the mouth open? What is said about the sensibility of touch?

CHAPTER XXIX.

The Skin.—Perapiring Apparatus.—Cleanliness.—Nails.—Hair.

THE most obvious use of the skin is to protect the body, most of the external parts of which it covers. It is evident that to do this properly it must possess a great deal of elasticity, for the surface over which it is spread is constantly varying in extent. To every shifting posture of the body, each

bend of a limb or a finger, and expression of the face, the skin must adapt itself, and constantly be always stretching and contracting as the living being performs his ceaseless and ever-varying movements. This necessary elasticity is due not only to the nature of the tissue of the skin, but to a certain apparatus which it possesses for the purpose of supplying it with oil and moisture. These are as essential to keep it in a condition of elasticity as they are to preserve the same quality in leather; and without the free and regular application of oil and moisture, the skin, like the leather, will be liable to crack and give way.

The apparatus referred to consists of a great number of little tubes, or glands, as they are called, which are imbedded in the skin and open upon its surface. The openings are generally known as pores, and the fluid which is poured out of them is ordinarily termed the perspiration. It must be clearly of great importance to keep this apparatus in good condition, since the fluid or perspiration which it supplies is composed of that oil and moisture which are necessary to preserve the elasticity of the skin.

The integument which covers the body is composed, according to the anatomist, of

three layers, the most external of which is the *epidermis*, or cuticle. This in human beings is shed, not in one connected whole and at fixed periods, as the snakes cast their skins, but in small particles or scales, and at every moment. These, as soon as thrown off, are succeeded by new portions of cuticle, which in their turn give way to others, so that there is a perpetual shedding of this external part of the human skin. The cast scales of epidermis, if left upon the surface of the body, soon accumulate, and when mixed with the perspiration will, after forming a sticky paste, finally dry into a film of hard matter. The pores will be thus more or less stopped, and the apparatus to which they belong prevented from fulfilling its purpose of supplying the oil and moisture essential to the preservation of the elasticity of the skin. This will, in consequence, soon crack and break, and, moreover, become irritated, inflamed, and covered with all those ugly blotches that result from the various diseases with which it is sure to be affected.

The perspiring apparatus, among its other purposes, has the important one of acting as the medium through which the animal body gets rid of certain waste matter which,

if retained within, will do a great deal of mischief. An imperfect action of the pores of the skin in consequence of any neglect to remove the dead scales of the cuticle, or any obstruction, tends to create disorder in the internal organs, and some of the most fatal diseases have been justly attributed to this cause alone. On some holiday or other in Paris, the skin of a child was covered with gold-leaf, that he might take some fancy part in a procession, and he died in consequence, a few hours afterward, within his impervious shroud of gilt. The pores of his skin having been thus entirely closed, and the passage of the perspiration stopped, death was the result.

The simple process of washing the skin with warm water and soap is the best means of getting rid of the scales of the cuticle and dirty matter of any kind which may have been allowed to accumulate. The whole surface of the body should be cleansed at least once, and those parts which are not ordinarily covered (as the face and hands, which are exposed to dust or other filth from without) several times, each day. When the habit of washing the whole body has become a daily one, a small quantity of cold water alone will suffice for all purposes

of cleanliness. Miss Nightingale says, and says truly, that a single tumblerful will be sufficient for the purpose. Every child should be washed all over, night or morning, either by others or himself. In spring, summer, and autumn, the water should be of the temperature of the room; in winter, it may be used somewhat warmer. Every one should be provided, if he has not a bath-tub at his disposal, with a sponge or wash-rag, by means of which, after a little practice, he will be able effectually to bathe the whole of his person from any ordinary basin.

The nails require some care, both for the sake of decency of appearance and healthiness of condition. They should be cut regularly at the free ends, but not at the sides, and brushed with a nail-brush, but never scraped or filed. The little hangnails which are so troublesome may be prevented from forming by pushing down the film of skin which is constantly tending to encroach upon the lower part of the nail where it is joined to the finger. Biting of the nails is an odious practice, and will, when persisted in, not only destroy all beauty of the hand, but cause an irritation of the quick which is often very painful and difficult of relief.

The toe-nails are apt to become distorted and turn into the flesh from wearing shoes too tight and narrow. They should be cut regularly, like the finger-nails, at the free ends, and not at the sides; and when they show a tendency to grow too deeply into the flesh, this may be checked by making a semicircular gap in the middle of the projecting edge. Corns and bunions come from wearing ill-made shoes, and are only to be effectually relieved by paring. Their final riddance can be effected only with the aid of a good shoemaker.

The main requirements for the hair are an occasional washing with water, to which the yolk of an egg may be advantageously added, and frequent use of the comb and brush. The scurf, which is sometimes very abundant, is composed of the accumulated scales of the cuticle of the scalp, and is most effectually removed by the application of bay-rum and brisk brushing. The natural oiliness of the skin of the head is ordinarily quite sufficient for keeping the hair glossy and flexible, and pomatum or barber's nostrum of any kind will have no other effect than clogging it with a substance the presence of which renders thorough cleanliness impossible. For convenience' sake, it is

well for children to wear their hair generally short; but all that is required for its wholesome growth is a clipping, every month or so, of its ends.

Questions.—What is the purpose of the skin? How is the skin able to serve its purpose? How is the elasticity of the skin preserved? Explain the apparatus for transpiration. How many layers has the skin? What is the external layer of the skin called? How is the epidermis shed? Why is cleanliness of the skin necessary? What other purpose than before mentioned has the perspiring apparatus? What are the dangers of interfering with this? What is the best means of keeping the skin in a wholesome condition? What can you say about bathing? How should the finger-nails be cut and treated? How should the toenails be cut and treated? What is the best treatment for the hair?

CHAPTER XXX.

Accidents. — Falls. — Cuts. — Bruises. — Fractures. — Bleedings, etc.

CHILDREN will get occasionally cut, bruised, and otherwise maimed in the course of their various odd antics and rude sports. As they cannot have always a parent, nurse, or doctor at their side to apply such skill as they possess, and the family medicine-chest

at hand to furnish the remedies it may contain, they should be able, with the means they are all more or less supplied with, to do something for themselves or their comrades in case of any of the common accidents to which they are liable. They should know how to stop bleeding, bind up a wound, and relieve a fallen companion. The water which is to be obtained at every pump or well, pond or lake, brook or river, the handkerchief which ought to be in every child's pocket, and such articles of clothing as he is sure to have on his back, if properly made use of, will be sure to be of service in most cases, and may sometimes be the means of saving life.

When a child receives a shock, from a fall or any cause whatsoever, and is stunned, as it is termed, and whether it should be a fainting fit, concussion of the brain, or anything else, his comrades must not be eager, as they generally are, to lift him up and force him to his feet. The lying position he naturally takes is generally the best for him, and nothing more need be ever done than to change with great care any posture which is evidently painful. Water should be applied freely to the head and a little to the lips, but no effort made to make the sufferer swallow

a full draught. His feet, legs, and lower part of the body should be covered with any warm garment at hand. Every part of the dress which is the least tight must be immediately loosened—the collar and wristbands unbuttoned, the chest and waist set free by opening the waistcoat (or unlacing the binding corset, in case it should be a girl who is already tortured by this strait-jacket of fashion), the garters unclasped, and the shoes taken off, or, at any rate, untied. All this, however, ought to be performed with great tenderness and care and the least possible derangement of the reclining posture, so essential to recovery. When the sufferer begins to revive, he should not be urged or permitted to make an effort to stand, and much less to walk. Even after he has apparently recovered and acknowledges himself to feel perfectly well, he must not be allowed to resume his pastime, but after due rest he should be carried, or partially supported at least, to the nearest house.

To an ordinary cut the best application at first is cold water. When the bleeding has somewhat stopped, the wounded part should be bound up tightly with a handkerchief, and, if so placed as to allow of it, a finger kept pressed upon the bandage direct-

ly over the cut. This will be all that is required for immediate safety in those cases where the flesh is not deeply penetrated and only the small blood-vessels are severed. Should the wound, however, be deep, and one of the larger vessels called arteries be cut—which will be discovered at once by the great and jerking flow and bright-red color of the blood—to prevent the sufferer from bleeding to death, a handkerchief should at once be bound firmly around the limb or other wounded part of the body between the cut and the heart, and a stick put under the bandage and twisted and tightened until the stream of blood is checked. To the cut itself another handkerchief, constantly wetted with cold water, and continuously pressed with the fingers, should be applied, and the wounded person kept in a lying posture, and conveyed to the nearest dwelling with the least possible motion. The surgeon should be sent for at once.

Children are very liable to bleeding from the nose, and, if not excessive, it will do more good than harm. When too abundant, the head should be thrown back, the arms raised, and cold water applied to the nose and back of the neck. Little plugs of paper or cloth dipped in fresh water may also be

thrust into the nostrils, and held in their place by the pressure of the finger.

In bruises and sprains cold water is again the sovereign remedy in an emergency ; but in applying it in these, as in all other cases, the handkerchief or other article which may be used for the purpose must be continually wetted afresh and left free to the air, that as much cold as possible may be produced by the evaporation of its moisture.

Bites and stings should be sucked, provided the lips are free from cracks or sores, and then covered with a wet handkerchief.

The bones of children, which are more flexible than those of grown-up persons, are less apt to break than bend, but they do sometimes break. When, after a fall or other accident, a fracture is suspected of the hand or arm, it should be supported in a sling (made by folding a handkerchief once triangularly) and tied by its free ends around the neck. If a foot, leg, or thigh be broken, it will be necessary to carry the sufferer, however short the distance, to some house (if his home be not near). This will be best done by placing him at full length on a shutter or broad plank, which should be borne upon the shoulders of any persons called upon to aid.

Children will often run splinters, needles, or pieces of glass into some parts of their bodies, or even swallow hooks, and thus become themselves the victims, instead of the intended fish, of their cruel sport. Any foreign body, like a needle or piece of glass, should be removed at once; and, if this be not practicable, a large warm poultice should be applied continuously until the doctor's skill may be made available. In case the would-be sportsman has caught himself, instead of the fish, the hook, after severing it from the line, must be pushed through the flesh, and not drawn back, lest it catch with its barbed ends, and add to the torture of the wound. If the hook should be swallowed, the way to release it is to pass along the line a round rifle-ball, drilled with a hole for the purpose, and it will fall to the hook by its weight and press it out from the flesh of the throat, in which it is imbedded.

Fire-arms of all kinds should be studiously avoided by young people for accidents by their reckless use are seldom to be remedied by any intelligence of their own, nor often even by the surgeon's skill. Slight burns, from the eruptions of crackers, squibs, or forbidden gunpowder, are best relieved by an immediate use of cold-water applications and poultices.

Children, notwithstanding their familiarity with good old Dr. Watts's nursery verses,

“Let bears and lions growl and fight,” etc.,

will occasionally fight; and if fight they will, let them always fight “fair,” as it is called. They should double up their fists squarely, that they may strike flat, and aim only at the less vulnerable parts of the bodies of their antagonists, avoiding the eye, the temples, the pit of the stomach, where a sudden blow is often fatal, and other delicate places. Kicking is most dangerous, and unworthy of any chivalrous child; so are butting with the head, thrusting with the projecting knuckles, gouging or tearing with the nails, biting, or striking with a stick, weapon, or anything but the square fist.

Young people not only owe obedience to their parents and teachers, but to all other authorized guides. The doctor's directions in case of illness should be strictly followed; for it is not less, but more important, in fact, that his rules regarding diet and regimen should be obeyed than that his drugs should be swallowed. Rest he is sure to advise in almost all acute diseases; and nothing is more helpful to the recovery of health, whether from a broken arm or sick stomach.

The part affected must not be used; the lungs must have rest by ceasing from unnecessary talk; the stomach must have rest by abstaining from eating any but the simplest food; the eye must have rest by shutting out the light; and the muscles, if bruised, must have rest by refraining from exercise; and the bones, if broken, must have rest, lest motion should prevent them from knitting together.

Whatever may befall a youth or any of his comrades, it should be recollected that, to be of service to himself or to them, he must retain his presence of mind. He will neither be able, without it, to use effectually what knowledge he may possess, or to avail himself advantageously of that possessed by others.

Questions.—What is the proper treatment in case of a fall? How should you treat a cut? How should the bleeding of an artery be checked? How is bleeding from the nose to be treated? How are bruises, strains, bites, and stings to be treated? What should be done in case of a suspected fracture of the arm? What should be done in a fracture of the leg? What should be done in case of splinters, etc.? What is the best means of releasing a swallowed hook? What is the proper application to burns from gunpowder? What is said about fighting? What about rest? What about presence of mind?

APPENDIX.

It is proper to state that the theory of animal heat, as set forth in Chapter VIII., is disputed by some chemists and physiologists of the present day; for example, Von Pettenkoffer, of Munich, says:

“There is a wide-spread opinion that the breathing of air rich in oxygen effects a more rapid transformation of matter—a more rapid combustion, as we say—in the body. Even great inquirers and thinkers have considered that we only eat and imbibe nourishment to satiate the oxygen streaming through us, which would otherwise consume us. We know well enough that the quantity of oxygen we imbibe does not depend on the quantity in the air we breathe, but far more on previous changes in and the amount of transformation of matter in the body, which are regulated by the requirements of breathing. The inhalation of oxygen is not a primary, but a secondary, thing. When we inhale air at every breath richer than usual in oxygen—for example, when breathing highly compressed air, as divers do, or laborers on the pneumatic foundations of bridge-piers—the result is not a larger consumption of matter and an increased production of carbonic acid, but merely a decrease in the number of inhalations. If in air of ordinary density we make

about 16 respirations in a minute, in air of greater density we should involuntarily make only 12, 10, or 8, according to the density and our need of oxygen: all else remains the same."

THE DIGESTIBILITY OF FOOD. (*Beaumont.*)

Beef, $2\frac{1}{2}$ to 3 hours.	Eggs, 3 to 4 hours.
Veal, 5 hours.	Good cheese, somewhat old, $3\frac{1}{2}$ to 4 hours.
Mutton, 3 to $3\frac{1}{2}$ hours.	Rice, about 1 hour.
Lamb, $2\frac{1}{2}$ hours.	Oatmeal, less quickly digested than wheaten.
Pork (roasted), $5\frac{1}{2}$ hours.	Bread, $3\frac{1}{2}$ to 4 hours.
Young pickled pork, 3 hours.	Potatoes, $2\frac{1}{2}$ to $3\frac{1}{2}$ hours.
Sucking pig, $2\frac{1}{2}$ hours.	Beet-root, $3\frac{1}{2}$ hours.
Bacon, less than 3 hours.	Cabbage, etc., $2\frac{1}{2}$ to 4 hours.
Broiled venison-steak, $1\frac{1}{2}$ hours.	Sago, $1\frac{1}{2}$ hours.
Tripe, 1 hour.	Arrow-root, $1\frac{1}{2}$ hours.
Pigs-feet, 1 hour.	

TREATMENT OF THE DROWNED.

Many lives are lost during the bathing season through ignorance of the proper method of treating persons who are taken from the water in a state of insensibility. By following the plain and practical directions given below, which have the approval of the highest medical authority, persons apparently dead from drowning may be restored to life.

RULE I.—Expose the patient upon the nearest dry spot to a free current of air, rip the clothing away

from the waist, and give a stinging slap upon the pit of the stomach. If this fails to arouse the patient, proceed to force and drain away the water which has entered the chest and stomach, according to Rule II.

RULE II.—Turn the patient upon his face, the pit of the stomach being raised upon a folded garment above the level of the mouth. For a second or two make steady pressure upon the back of the stomach and chest, and repeat it once or twice until fluid ceases to flow from the mouth.

RULE III. —Quickly turn the patient upon his back, with the bundle of clothing beneath it, so as to raise the lower part of the breastbone higher than the rest of the body. Kneel beside or astride the patient, and so place your hands upon either side of the pit of the stomach, upon the front part of the lower ribs, that the fingers will fall naturally into the spaces between them, pointing toward the ground. Now, grasping the waist, and using your knees as a pivot, throw your whole weight forward, pressing upward, as if to force the contents of the chest and stomach out of the mouth. This bends the yielding ribs together, lessens the cavity of the chest, and foul air is forced out, or *expired*. Steadily increase the pressure while you count one, two, three, then *suddenly let go*, with a final push, which springs you back to an erect kneeling position. The elastic ribs instantly spring back to their natural position, the cavity of the chest is enlarged, and to prevent a vacuum fresh air is drawn in, or *inspired*. Thus is produced *breathing*, or *respiration*. Remain erect upon your knees while you count one, two; then throw your weight forward, and proceed again as before. Repeat these bellows-like movements at first about five times a minute, grad-

ually increase them to about fifteen times a minute, and continue with the regularity and rhythm of the natural breathing which you are imitating. If another person be present, let him with the left hand hold the tip of the tongue out of the left side of the patient's mouth, with the thumb and finger covered with a handkerchief, while with the right hand he grasps both wrists and pins them to the ground above the patient's head.

AFTER-TREATMENT.

When breathing first returns, dash violently a little cold water occasionally in the face. As soon as the breathing has become natural, strip and dry the patient rapidly and completely, and wrap him in blankets only. Give hot brandy-and-water, a teaspoonful every five minutes the first half hour, and a table-spoonful every fifteen minutes for an hour after that. If the limbs are cold, apply friction. Allow abundance of fresh air, and let the patient have perfect *rest*.

In suffocation from coal-gas, fire-damp, smoke, or from hanging, use Rules I. and III. only, with the after-treatment.

PRACTICAL SUGGESTIONS.

Avoid delay.—Promptness is of the first importance. *A moment lost may be a life lost.* Waste no time in gaining shelter; when gained, it oftener harms than helps the patient.

Prevent crowding around the patient.—However difficult to accomplish, this is imperative. The circulation of air must not be obstructed, nor may the patient, when rallying, be urged into conversation.

Avoid attempts to give stimulants before the patient is well able to swallow.—It obstructs respiration, and may choke the patient.

Avoid hurried, irregular motions.—In the excitement of the moment this is almost inevitable. Just as a flickering candle moved carelessly goes out, so the heart, when beating imperceptibly, requires but little cross motion or interruption to cause it to stop. The movements of Rule III. should, therefore, be performed with deliberation and rhythm.

Avoid an overheated room.—The animal heat which is required cannot be supplied from without ; it must be generated within the system. This is best promoted by a free supply of cool air and the use of internal stimulants. The vital heat resulting is best retained by blankets alone to the surface.

Avoid giving up the patient too soon to death.—Any time, from a minute to an hour or two, you may be on the very threshold of success, though no sign of it be visible. Success is rarely achieved in less than twenty minutes. The patient should avoid exposure for a few days after recovery, or chest troubles may ensue.

THE END.



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
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